



Exploiting Microorganisms for Animal Feed Production

Jørgensen, John Bagterp

Publication date:
2011

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Jørgensen, J. B. (Author). (2011). Exploiting Microorganisms for Animal Feed Production. Sound/Visual production (digital)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



What Next Agriculture II

The 7th Malaysia International Agro-Business Conference 2011

13-14 July 2011, Putra World Trade Centre, Kuala Lumpur, Malaysia



Exploiting Microorganisms for Animal Feed Production

Prof. Dr. John Bagterp Jørgensen

UniBio A/S



Technical University of Denmark



Agenda

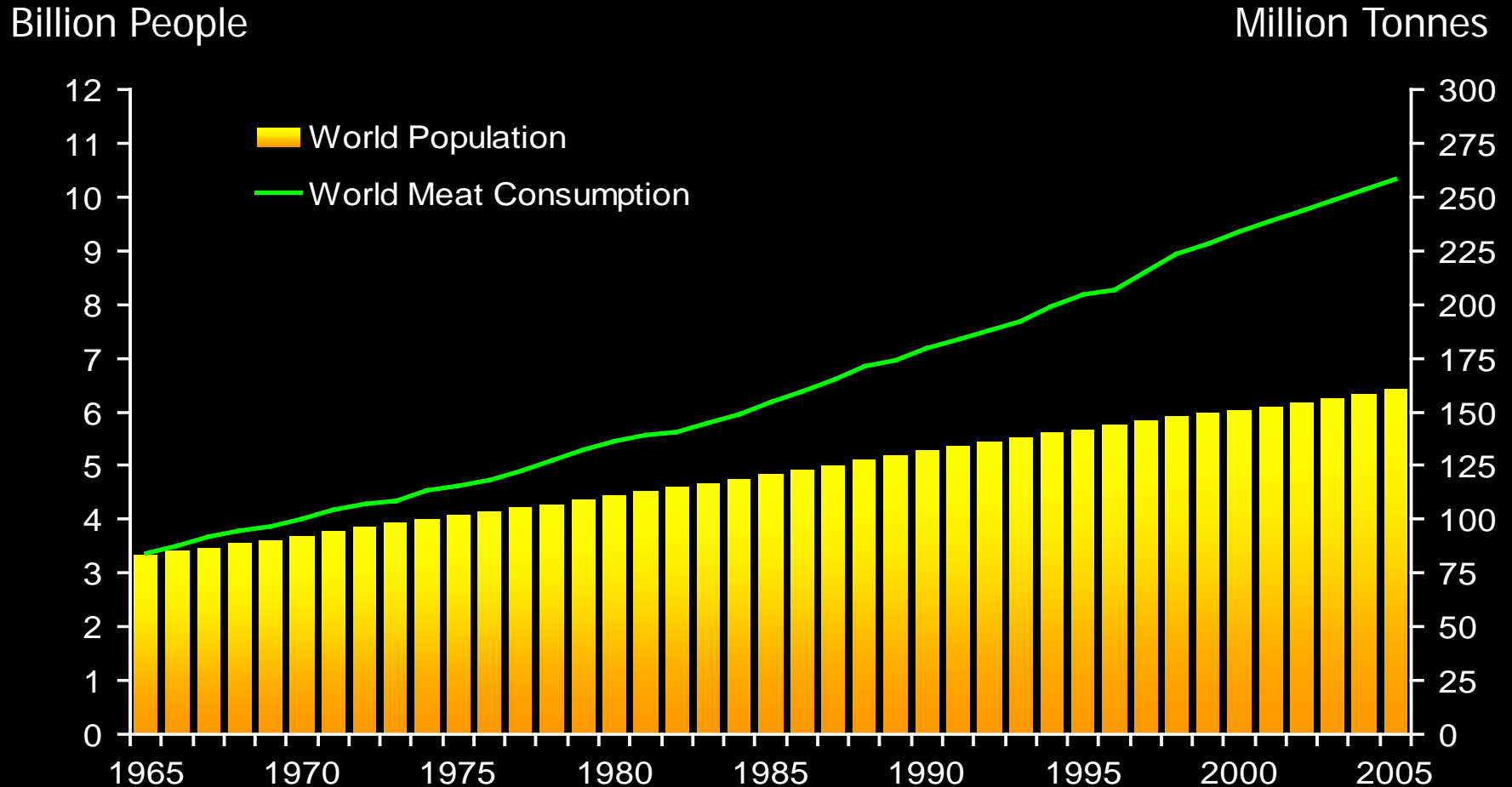
1. Population Growth & Proteins
2. Single Cell Protein (SCP) – UniProtein®
3. Process Technology for SCP Production
 - Fermentation
 - Downstream
4. UniBio A/S
5. Commercial Opportunities

POPULATION GROWTH & PROTEINS

A Growing Population Eating Meat

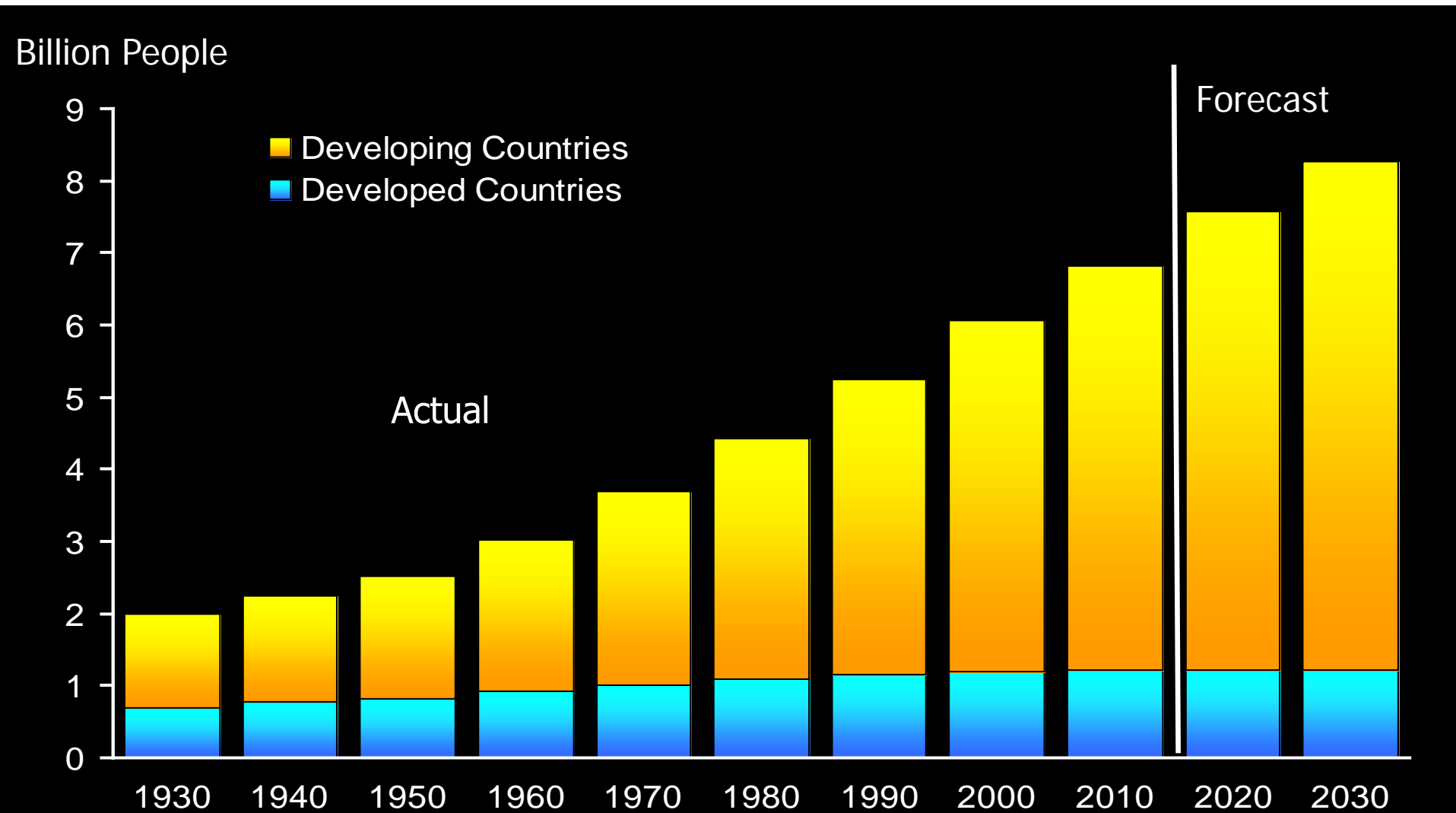
- World population and GDP growth driving meat consumption, more meat means more grain ... feed demand and animal feed supplements are rising
- Global customers have greater buying power and feed grain raw material prices have been favorable ... but changes are in store for the global poultry and livestock industry ... the result of the boom in ethanol and biodiesel production.
- Health and Food Safety concerns are putting pressure on better quality feed ingredients
- There is growing concern with environmental issues in animal agriculture

World Population Growth & Meat Consumption



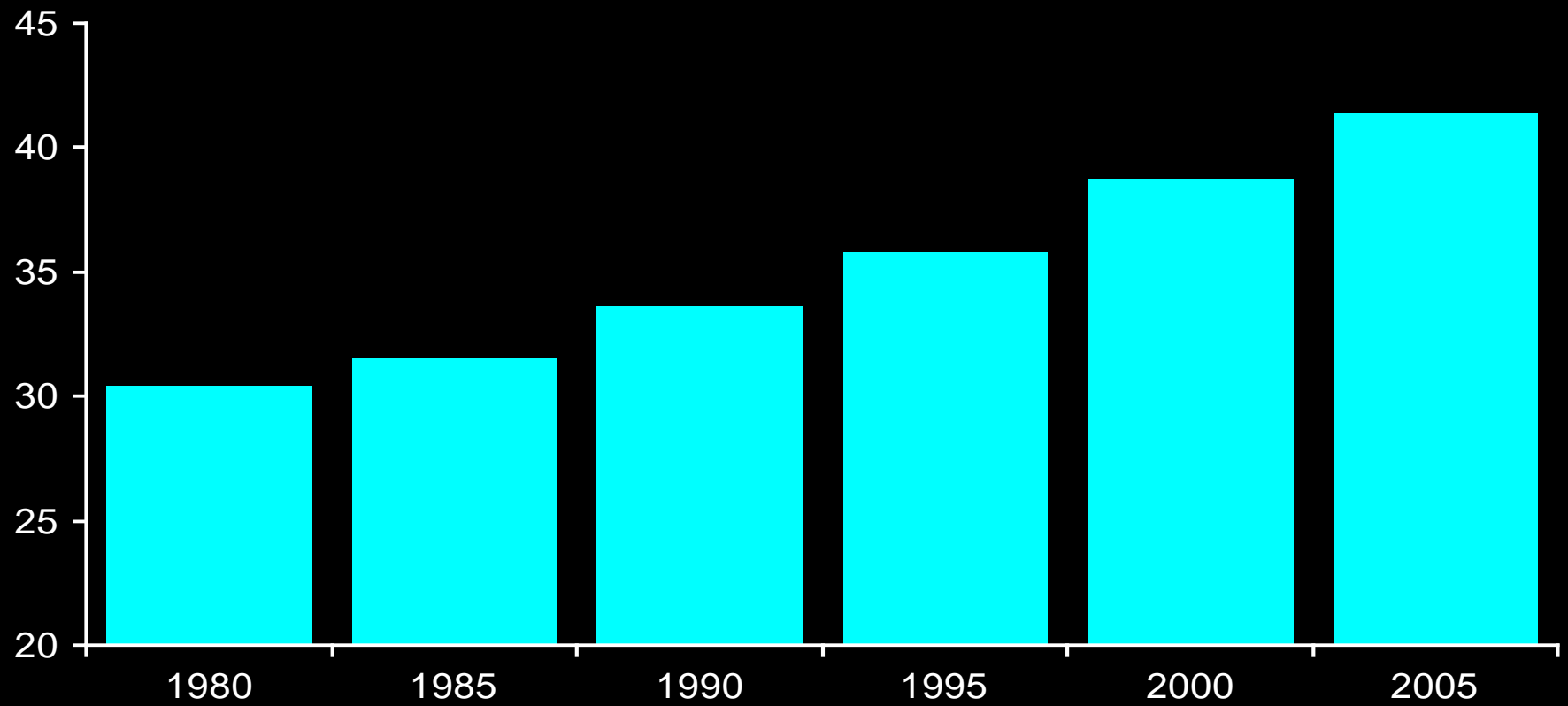
Source: United Nations, FAO

World Population

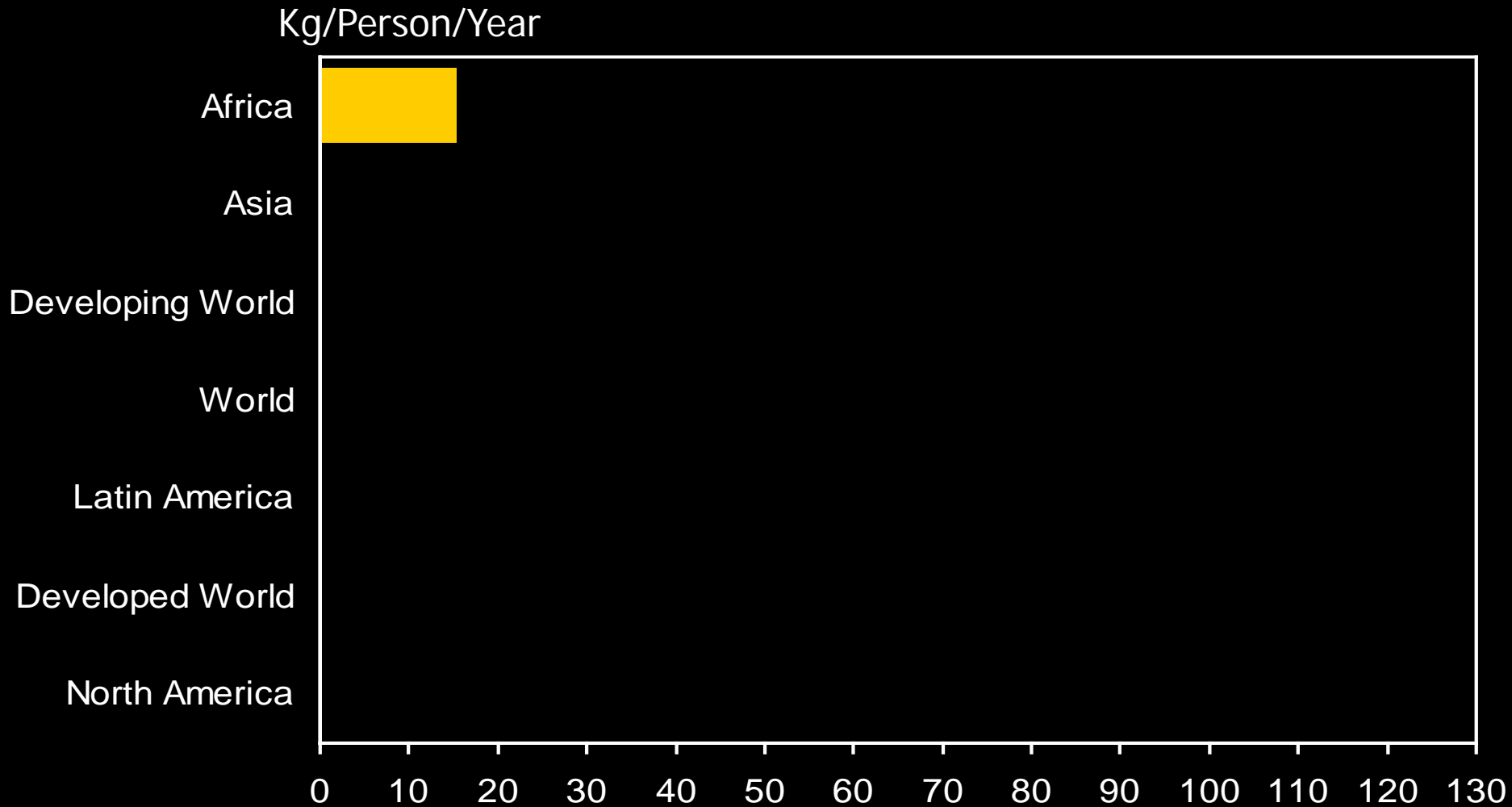


World per Capita Meat Consumption

Kg/Person/Year

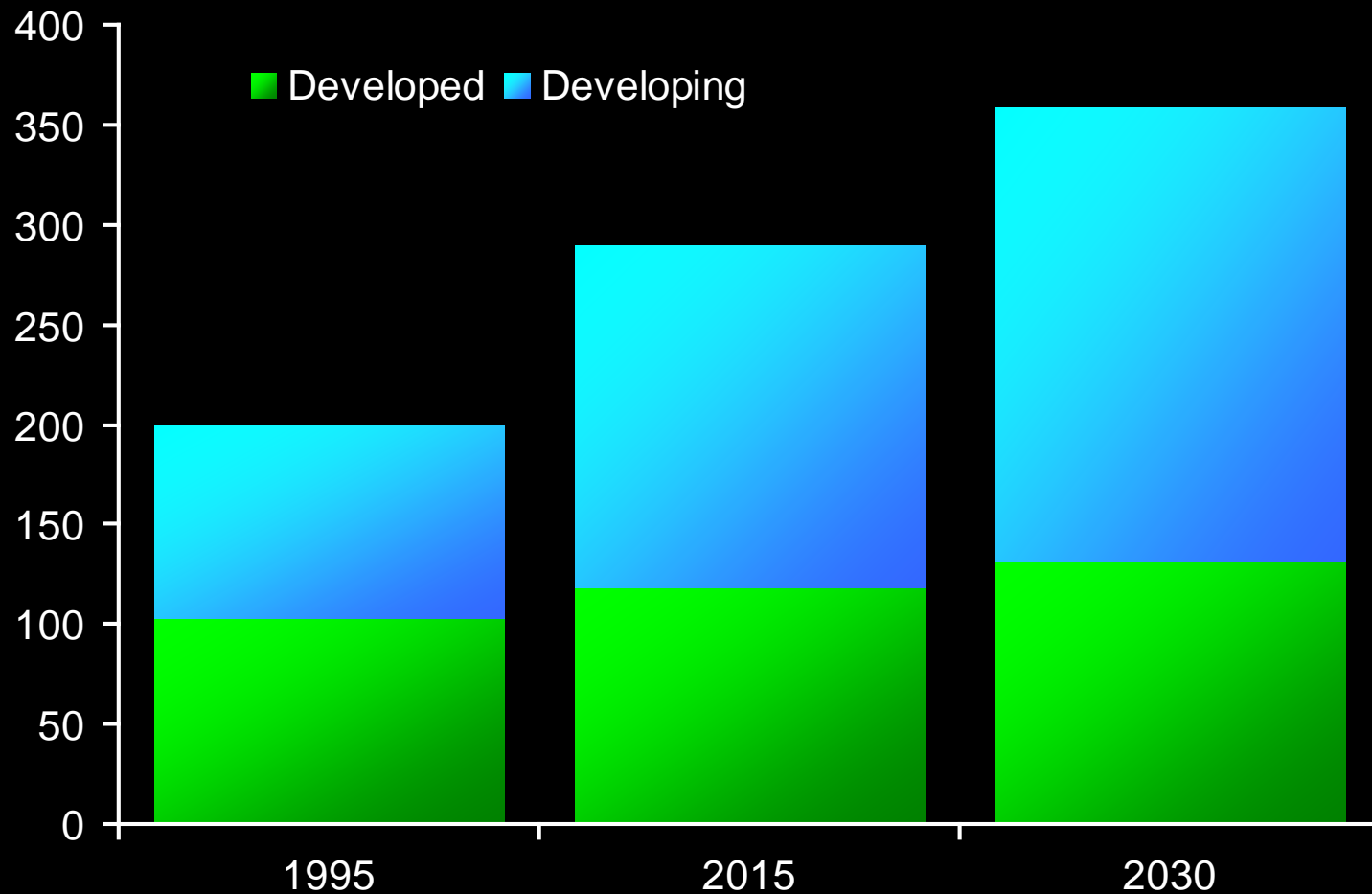


World per Capita Meat Consumption by Region



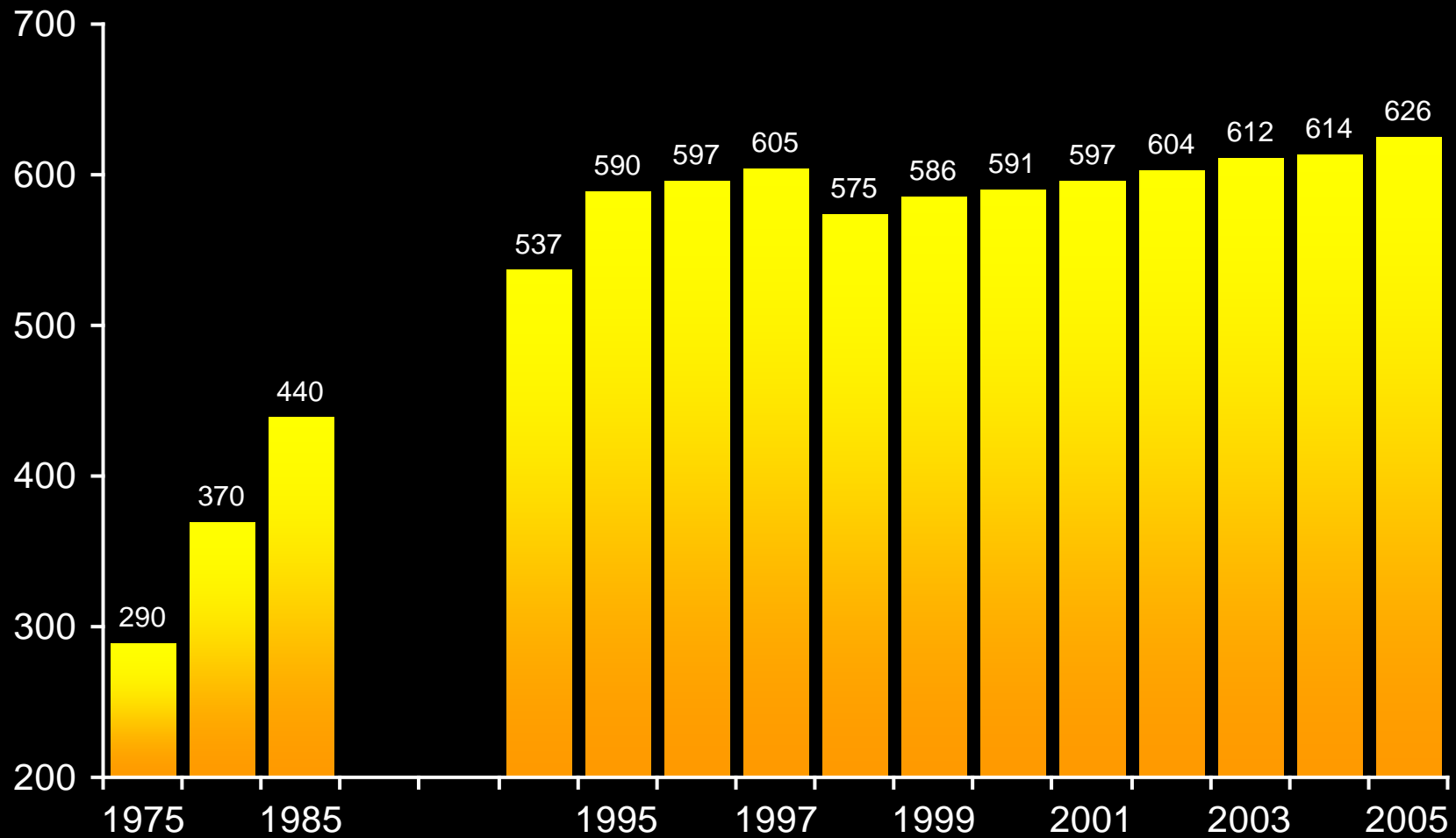
World Meat Consumption 1995-2030

Million Tonnes



World Compound Feed Production

Million Tonnes





Outlook

- Worldwide we need to feed 2bn more people by 2030 (compared to 2000)
 - People in developing countries consume more and more meat
 - This means producing at least 60m tonnes protein more a year by 2030
 - Proteins (UniProtein®) can be manufactured from natural gas in a process patented by UniBio A/S
 - By using natural gas (eg. by reducing flaring) CO₂ emissions are reduced and the natural gas is used to secure future sources for protein
 - Malaysia can decrease imports of vital proteins
-

SINGLE CELL PROTEIN



What is UniProtein®?

- UniProtein® is a protein-rich biomass produced by microbial cultures with methane or methanol as the only carbon and energy source.
- The final product is a homogeneous, reddish brown, non-dusty granule.
- UniProtein® is not genetically manipulated, has a long shelf life and is easily stored and mixed with other feed compounds and foodstuffs.
- UniProtein® has been tested as feed for salmon, calves, pigs and chickens with positive results in terms of accept and growth. In addition, an increased resistance to disease has been observed in salmon fed with UniProtein®.



Single Cell Protein

Methane or
Methanol



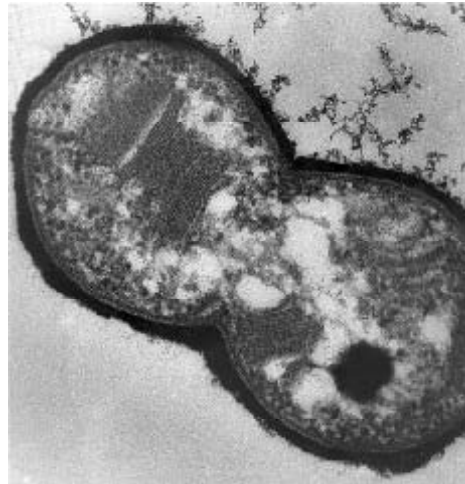
Oxygen



Nitrogen



Minerals



Methylococcus capsulatus



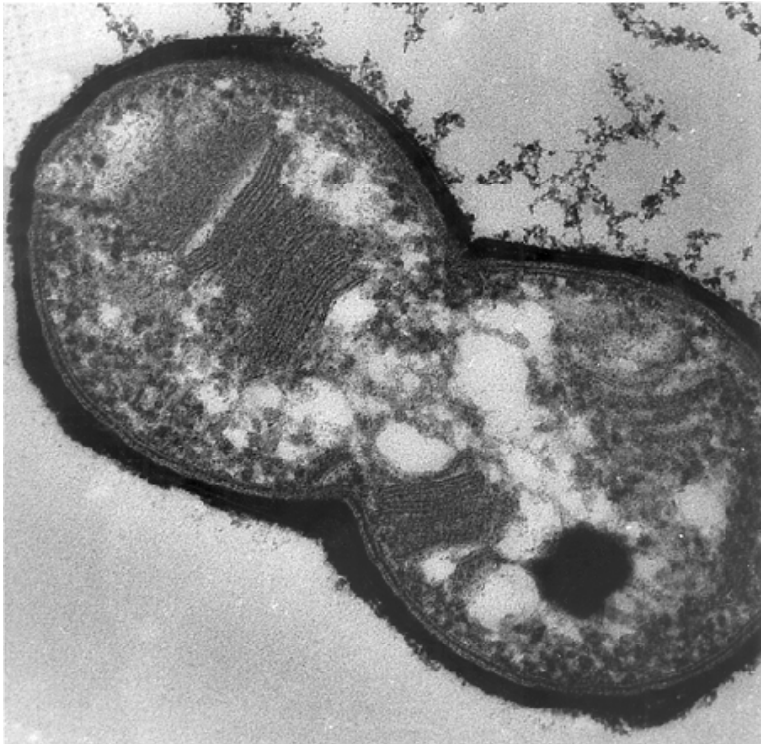
Single Cell Protein

UniProtein®

Chemical Composition

% Dry Weight

Methylococcus capsulatus



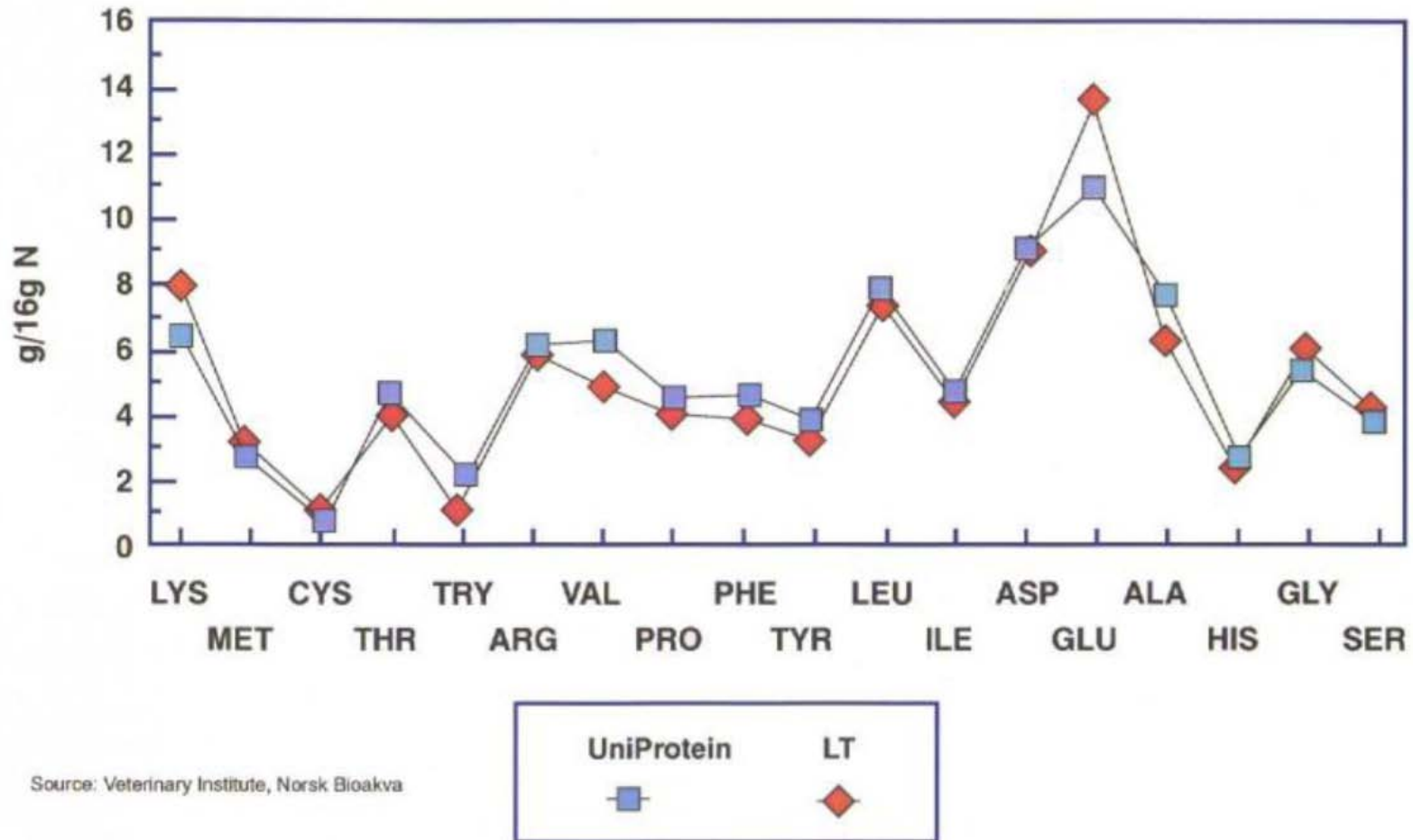
- Crude protein 70%
- Lipids 10%
 - Phospholipids (Phosphatidylethanolamine)
 - 85% palmitic acid (C16:0) & palmitolenic acid (C16:1)
- Fiber 1%
- Carbohydrates 12%
- Minerals 7%
- The product is virtually free of toxins, dioxin, and heavy metals due to the controlled production process and minerals used are food grade

Chemical Composition

Composition of UniProtein®		Amino Acid Composition		Minerals		Vitamins	
Crude protein (N 6.25)	70.6%	Cysteine	4.5 g/kg	Phosphate	31.9 g/kg	Vitamin A	<1 IU/g
Crude fat	9.8%	Methionine	19.8 g/kg	Sulphate	16.1 g/kg	Thiamin B ₁	12.1 mg/kg
Crude cellulose (fibre)	0.7%	Threonine	32.8 g/kg	Chloride	7.6 g/kg	Riboflavin B ₂	73 mg/kg
Ash 550	7.1%	Lysine	45.6 g/kg	Calcium	4.7 g/kg	Nicotinic acid	73 mg/kg
N-free extract	11.8%	Tryptophane	15.7 g/kg	Potassium	3.7 g/kg	Inositol	30 mg/kg
		Leucine	54.9 g/kg	Magnesium	2.1 g/kg	Vitamin E	<5 mg/kg
		Isoleucine	33.6 g/kg	Sodium	0.9 g/kg		
Nucleic Acids		Valine	44.8 g/kg	Iron	216.0 mg/kg	Fatty Acid composition	
Ribonucleic acid (RNA)	4.8%	Phenylalanine	32.9 g/kg	Copper	91.0 mg/kg	Fatty acid in extracted fat	94.0%
Deoxyribonucleic acid (DNA)	2.4%	Histidine	18.0 g/kg	Zinc	17.0 mg/kg	Relative distribution	
		Arginine	43.8 g/kg	Cobalt	3.4 mg/kg	C14:0 Myristic acid	4.1%
Carbohydrates Monosaccharides		Alanine	51.9 g/kg	Nickel	2.0 mg/kg	C14:1	0.5%
(after acid digestion)		Aspartic acid	65.1 g/kg	Manganese	<1.0 mg/kg	C15:0	0.7%
Glucose	4.5%	Glutamic acid	77.1 g/kg	Selenium	0.017 mg/kg	C16:0 Palmitic acid	49.3%
Other Monosaccharides	<0.5%	Glycine	35.7 g/kg	Cadmium	>0.00002 mg/kg	C17:00	6.0%
Polysaccharides		Proline	31.7 g/kg	Arsenic	0.051 mg/kg	cyc 17:0	6.2%
Starch	2.4%	Serine	26.6 g/kg	Lead	0.00023 mg/kg	C18:0 Stearic acid	0.3%
		Tyrosine	26.0 g/kg	Mercury	>0.02 mg/kg	C18:1 Oleic acid	0.5%
		Ammonium nitrogen	0.03%			Unidentified	2.3%
		Amide	1.34%				
		Nitrate	<0.01%				
		Nitrite	<0.01%				

- UniBio A/S has developed a method to reduce Nucleic Acids to below 1%
- This will make UniProtein® applicable for human use
- When hydrolyzed the content of UniProtein® is approximately 75%

Amino Acid Profile



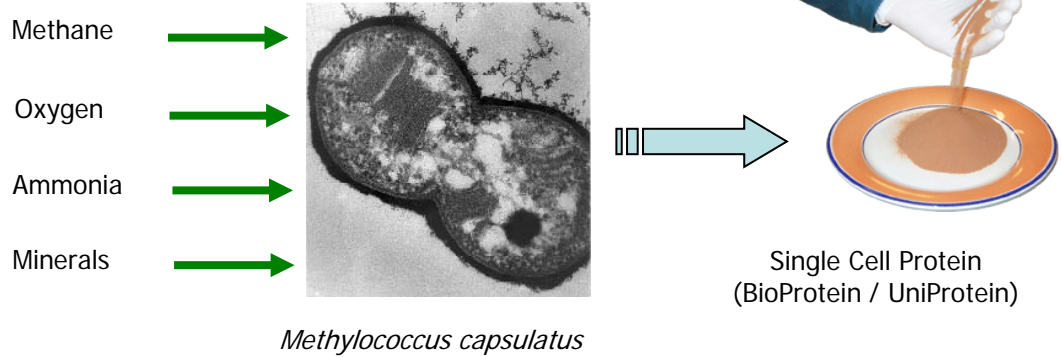
Source: Veterinary Institute, Norsk Bioakva

- The amino acid profile of UniProtein® compares well with LT-Fishmeal
- The amino acid profile is nutritionally favorable
- High content of methionine and lysine



Advantages of UniProtein®

- Environmentally sustainable
- Continuous development of process technology and product applications
- High and homogeneous quality compared to products in the current market (eg fishmeal)
- Does not contain toxins, dioxin or heavy metals



Applications of UniProtein®

PROTEIN APPLICATION

FUNCTIONAL EFFECT

- Mouth feel
 - Water absorption properties
 - Fat stabilisation
 - Adhesiveness
 - Whipping ability
 - Extrusion properties
 - Emulsification capacity
 - Coating properties
 - Viscosity capacity
 - Taste stabilisation/enhancement
- The largest user of protein additives is the foodstuff industry. The same functional effect can be achieved by non-protein based ingredients however proteins offer a good label as they appear as proteins in the declaration of product contents
 - Protein additives, especially aroma and flavour additives are widely used in other areas of the food business, for instance in confectionary, ready-made dishes, salads, snacks, imitation meat and cheese

NUTRITIONAL EFFECT

- Protein supplement
 - Increase of the biological value of other proteins within the product
 - Higher saturation degree
 - Immune response support
- The nutritional effect of proteins is used in a wide range of nutritional products, for example baby food, slimming drinks, tube feeding formulas, emergency rations and sports food in addition to common consumer goods in which a high content of protein is desirable

UniProtein® is a unique product whose applications substitute or outperform the applications of a range of established products within several segments

ANIMAL FOOD

- UniProtein® can be used as a supplement for all kinds of animals such as pets, poultry, cattle and fish
- Several of these animals have digestive system that cannot handle a diet solely relying on vegetable protein, resulting in a large demand for proteins manufactured from bacteria, yeast or animals

INDUSTRIAL USE

- Proteins are used industrially as binding material in eg lacquer and paint
- Aroma and flavour additives

HUMAN FOODS

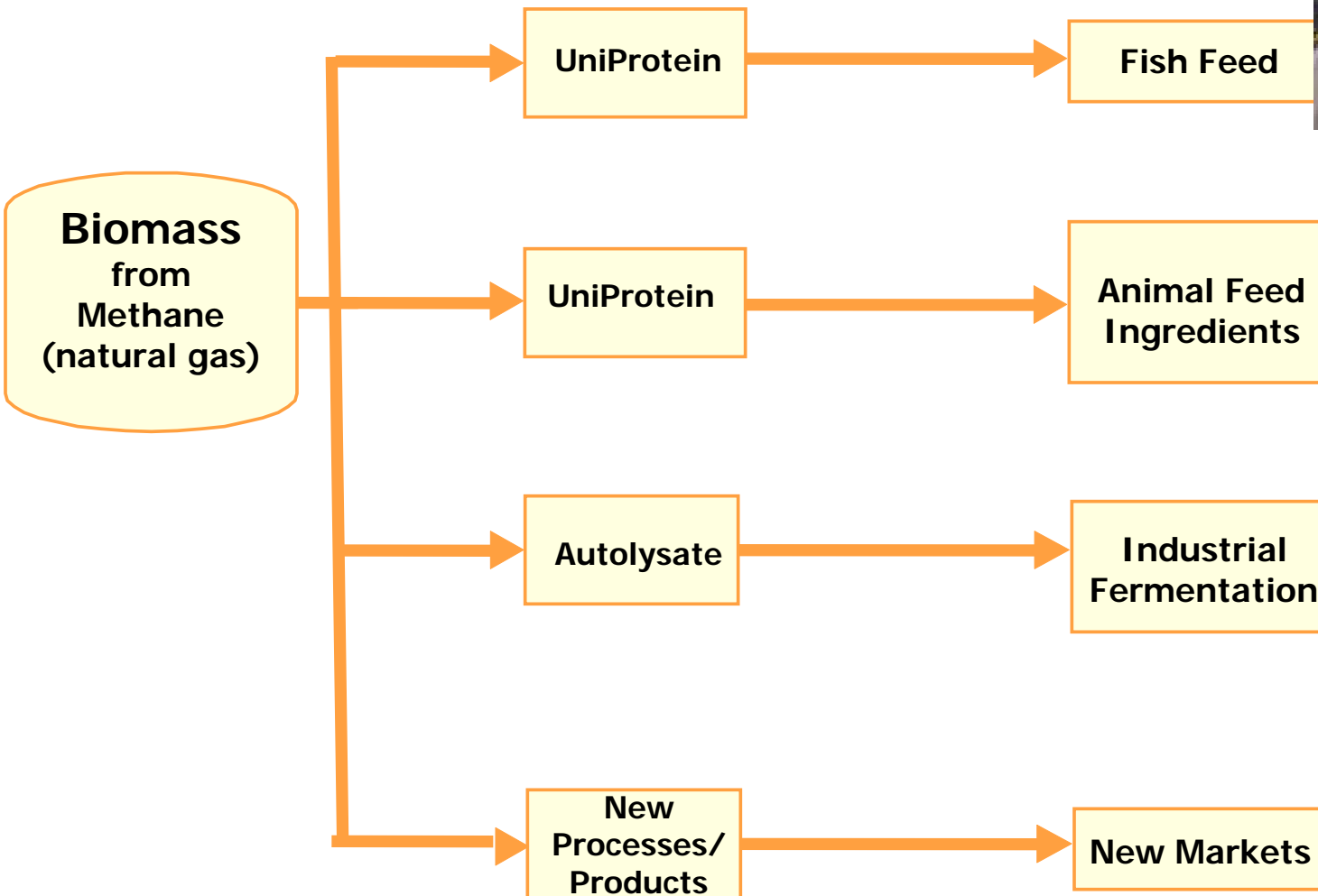
- Proteins are used as both a functional and a nutritional additive in a wide range of foods
- Proteins are especially in demand as they improve the final product specification
- UniBio has not applied for approval for UniProtein® for human use in the EU

UniProtein®

ANIMAL FEEDING TESTS

<u>SPECIES</u>	<u>Test</u>	<u>Institution carrying out test</u>	<u>Start date</u>	<u>Results report</u>
PIGS	<ul style="list-style-type: none"> ▪ Digestibility ▪ Balance / growth 	Foulum, Denmark	Jan-92	Oct-92
CALVES	<ul style="list-style-type: none"> ▪ Acceptability and functionality ▪ Digestibility ▪ Balance / growth 	TNO-Ilob, Holland	Feb-92	Sep-92
CHICKEN	<ul style="list-style-type: none"> ▪ Growth 	Foulum Denmark	Jan-92	May-92
SALMON	90-400g	Felleskjøbet, Norway Veterinary Institute	Aug-91	Apr-92
	600-1000g	Havforskningsinstitut, Norway (Institute of Marine Research)	Jan-92	Nov-92
	0.2-5g	<ul style="list-style-type: none"> ▪ Acceptability and functionality ▪ Digestibility ▪ Start feeding (growth) Akvaforsk, Norway	Mar-92	Nov-92

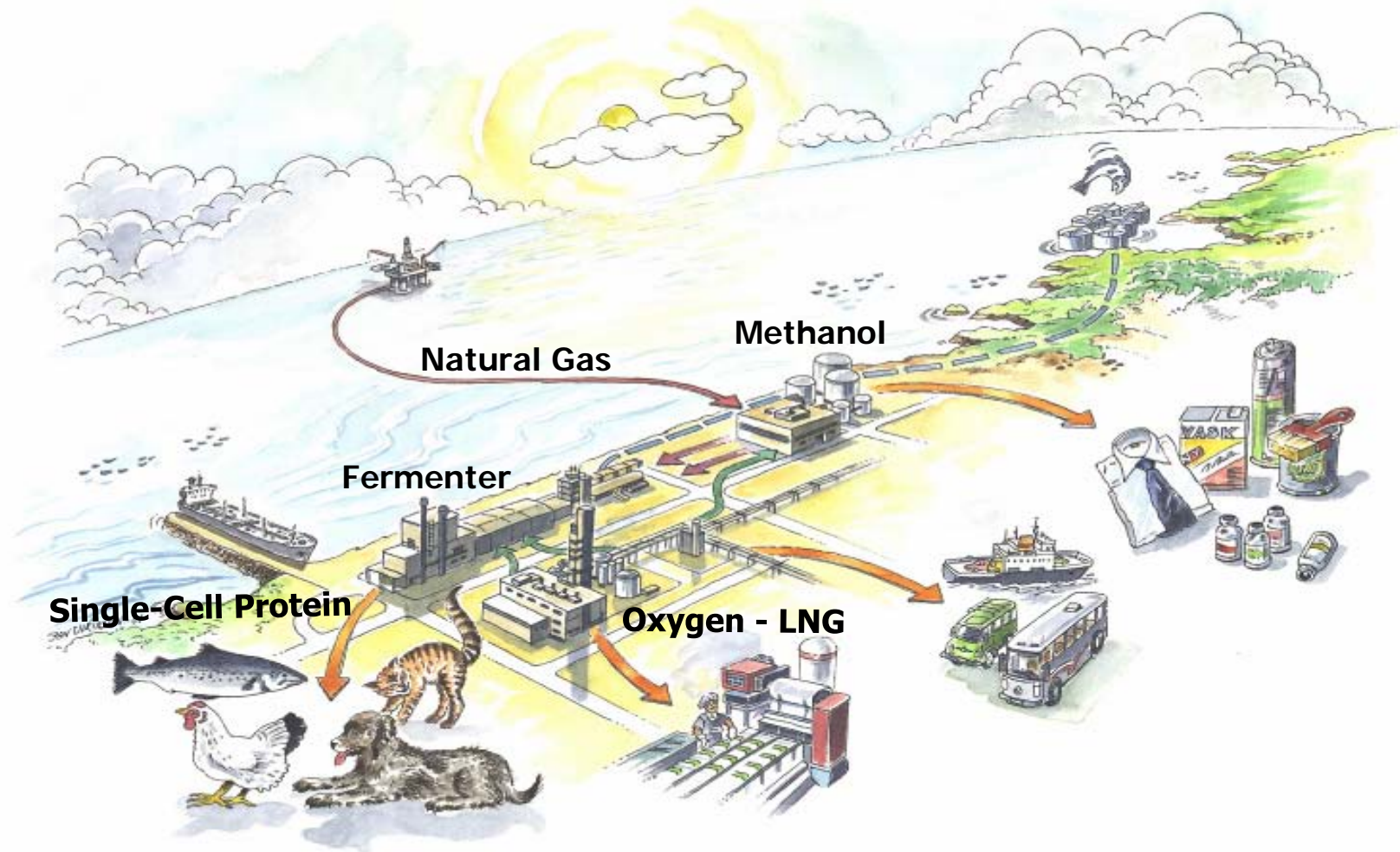
Process ➡ Products ➡ Markets



?

PROCESS TECHNOLOGY

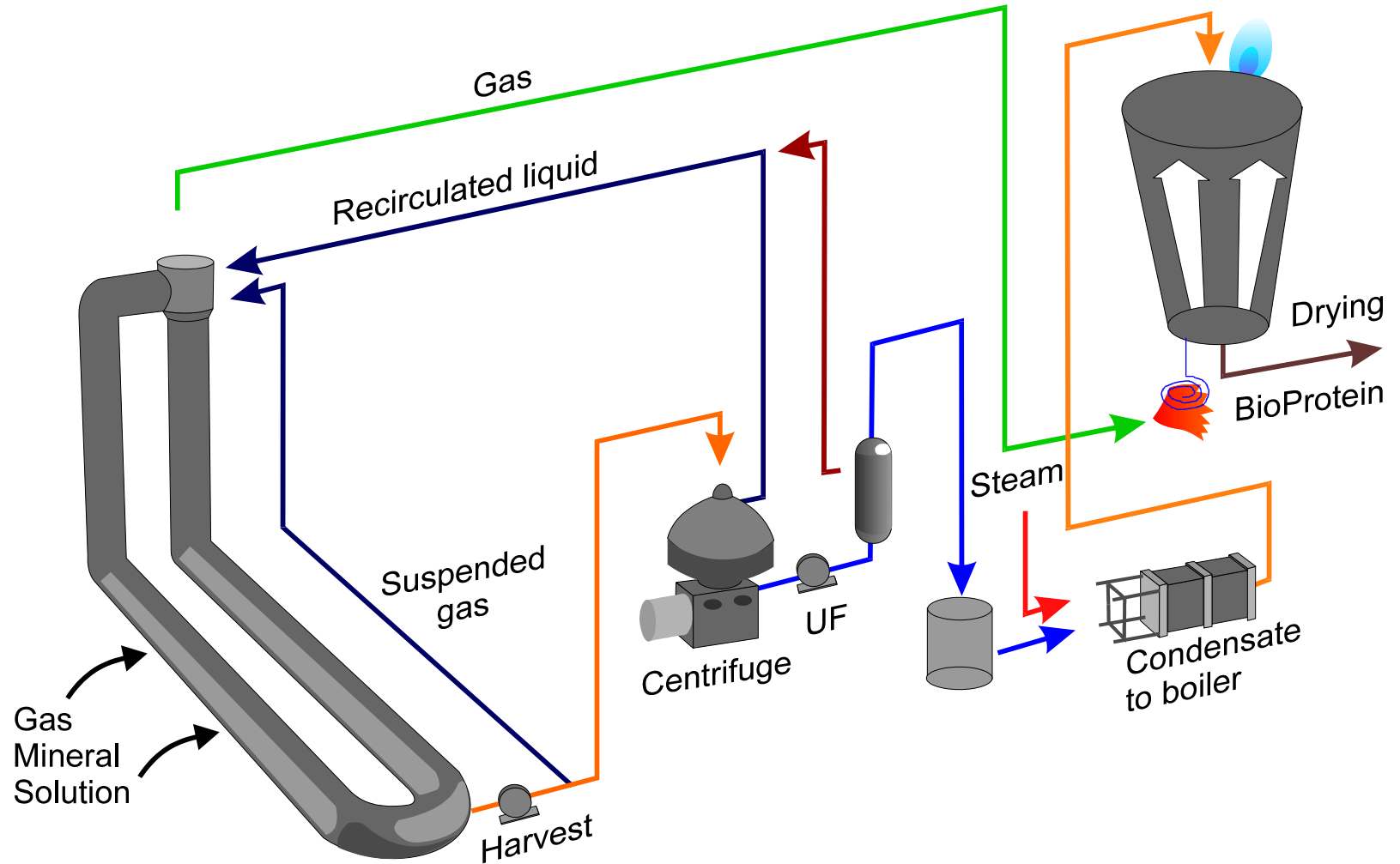
Industrial Complex for SCP Production



SCP Plant in Norway

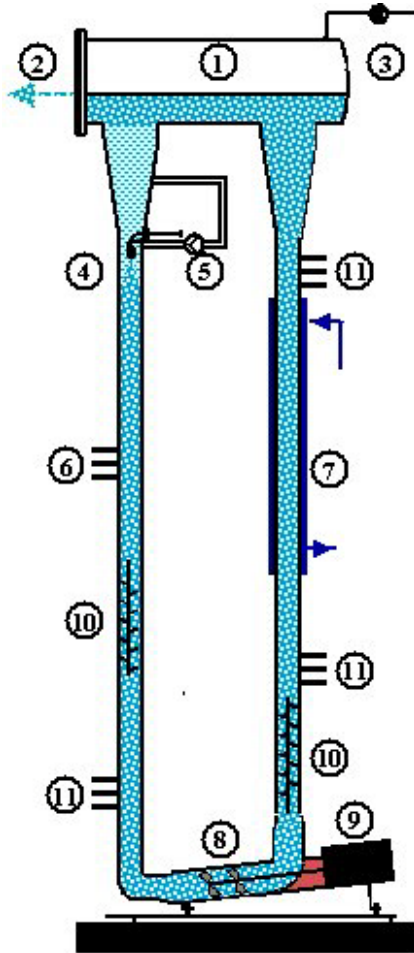


Process Diagram



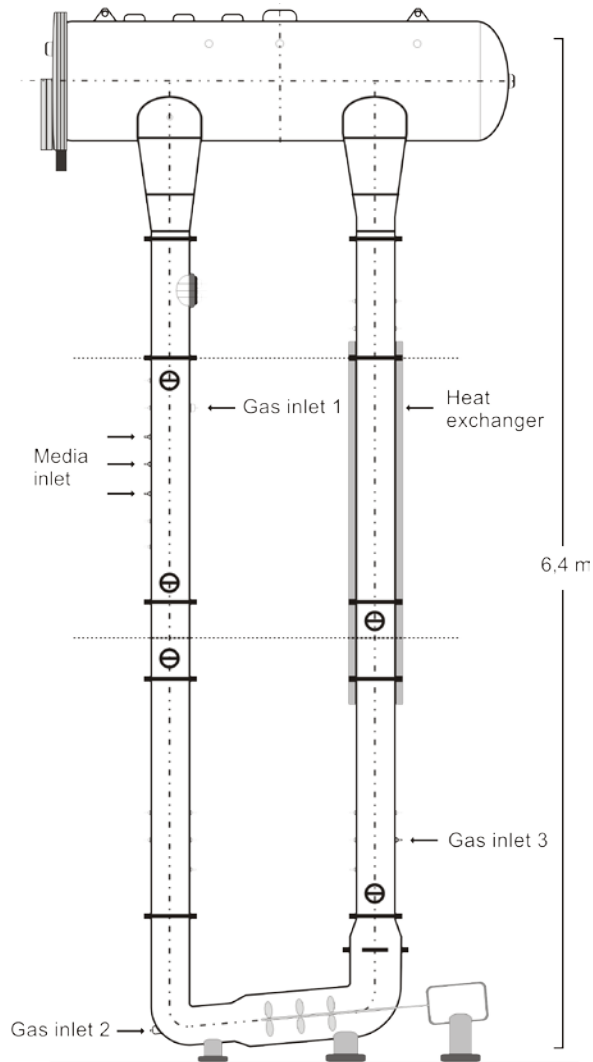


The Process in Brief

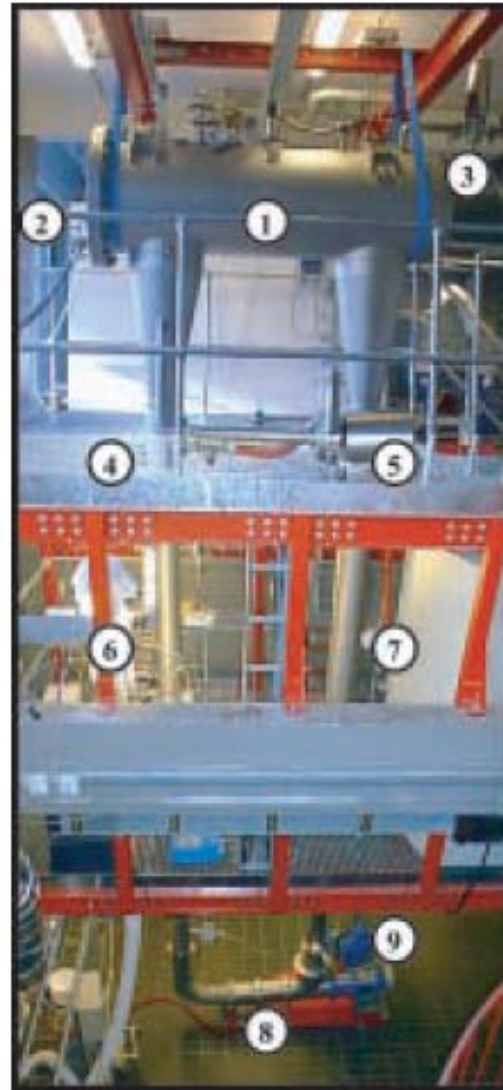
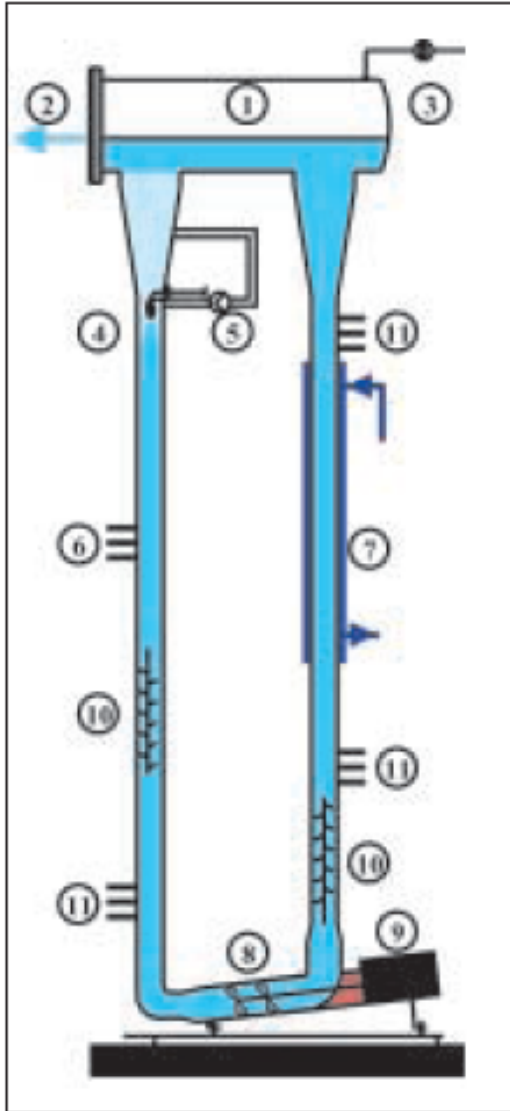


- UniProtein® is produced by methane gases and microorganisms in the form of the bacteria *Methylococcus capsulatus* (Bath) in a patented fermentation process in a U-loop fermentor.
- The gases are introduced at the start of the loop and stay in well-mixed contact with the liquid until they are separated in the headspace at the end of the loop.

Vertical U-Loop Reactor



U-Loop Fermenter @ DTU



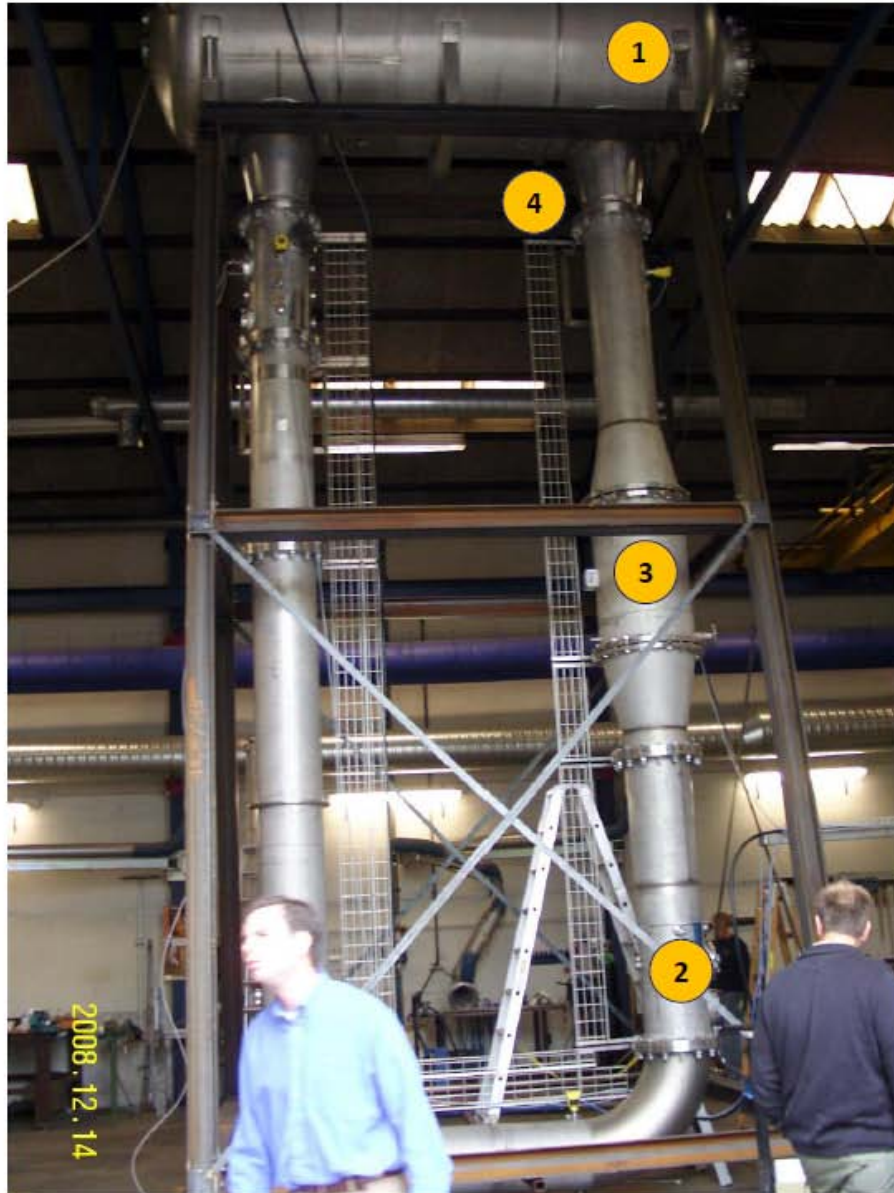
1. Degassing unit
2. Medium outlet
3. Gas outlet
4. Injector
5. Injector pump
6. Raw material inlet
7. Heat exchanger
8. Propeller pump
9. Pump motor
10. Static mixer
11. Sensor inlets



Pilot Plant - Trinidad & Tobago



THE NOZZLE U-LOOP FERMENTOR AT FACTORY ACCEPTANCE TEST



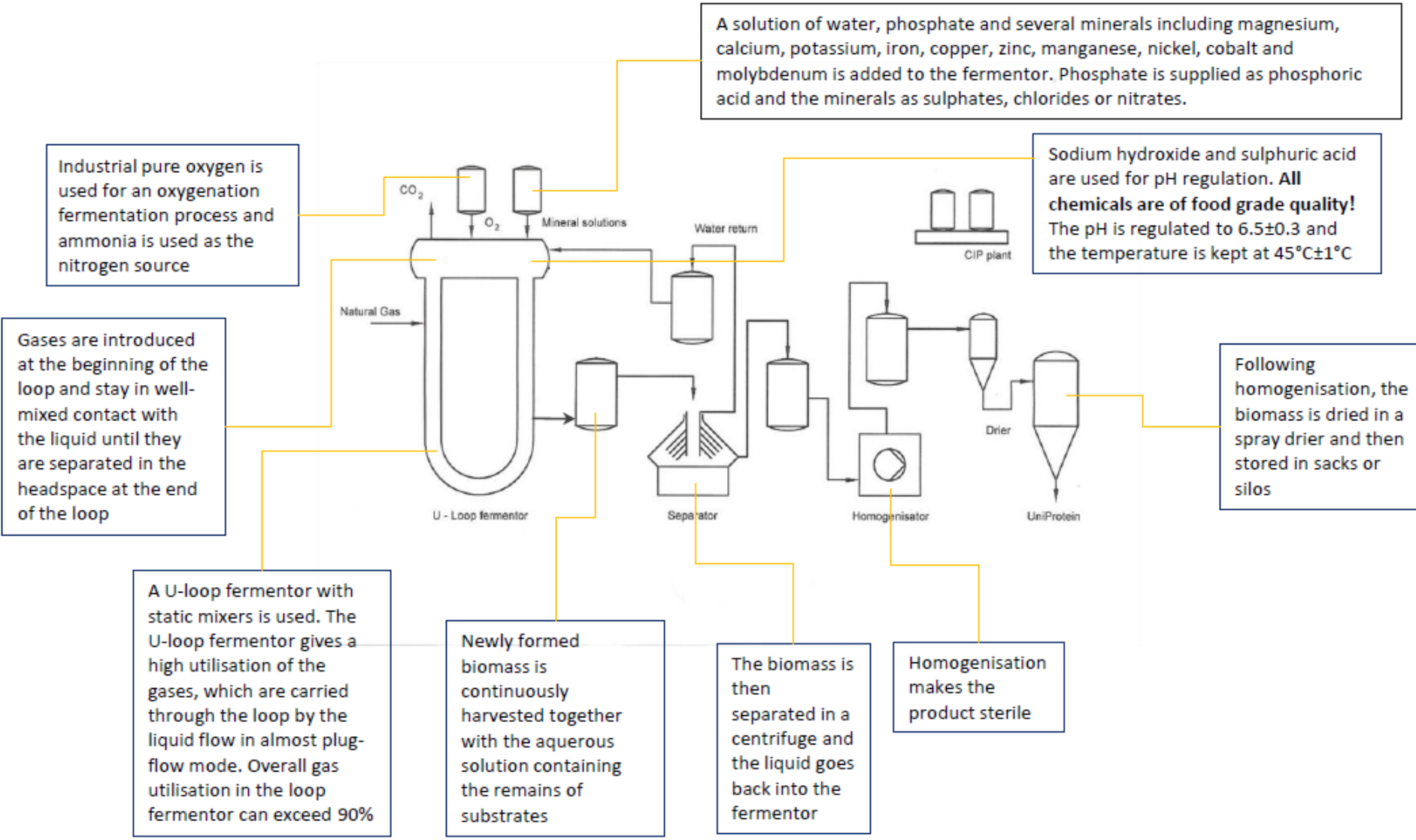
- 1 Degassing unit
- 2 Continuous harvest of biomass
- 3 Cooling
- 4 Propeller pump for moving the fluid through the loop



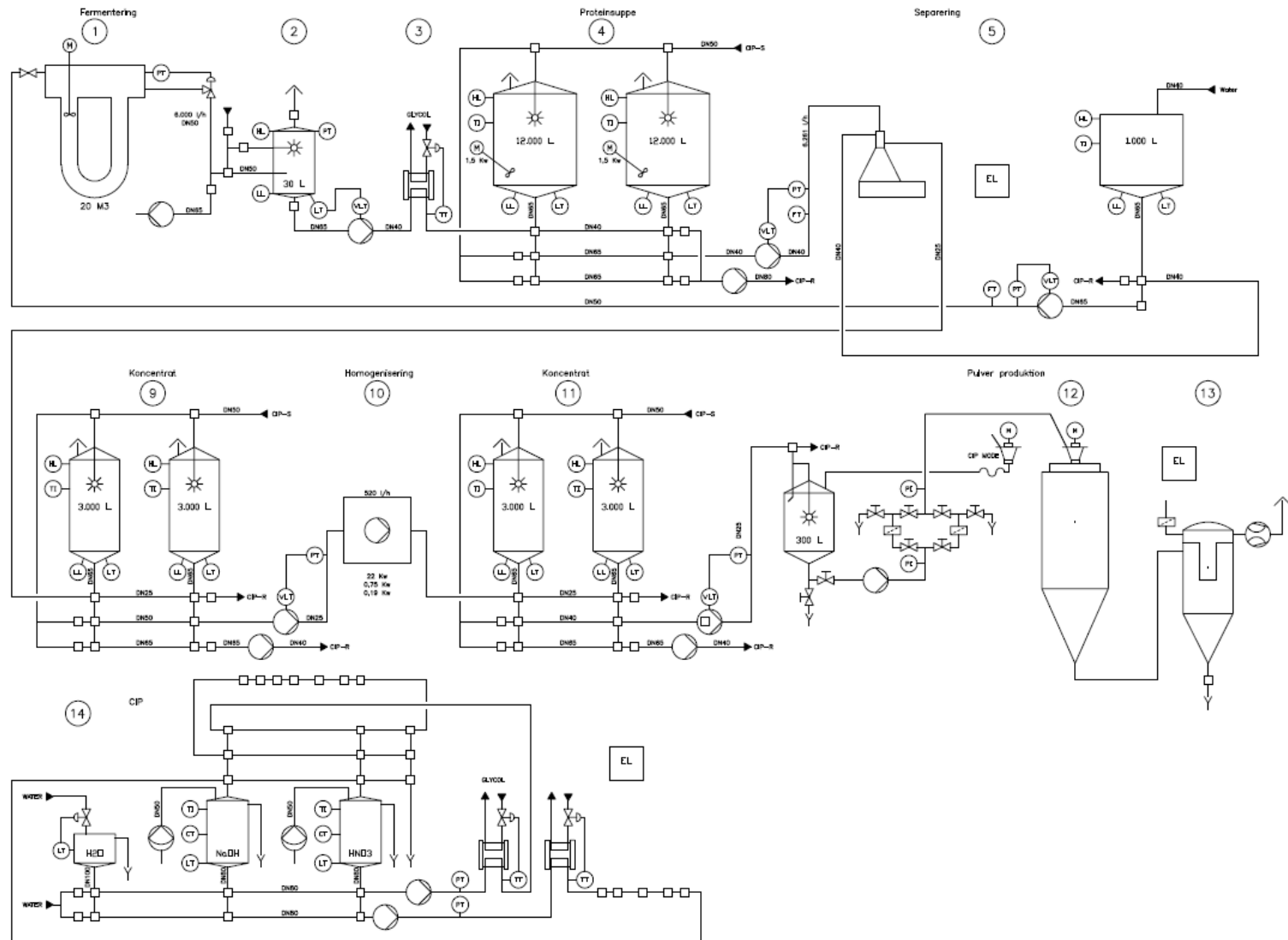
Pilot Plant - Trinidad & Tobago



UniProtein® is produced in a continuous patented fermentation process



UniProtein Plant – Flow Diagram



Fermenter & Centrifuge

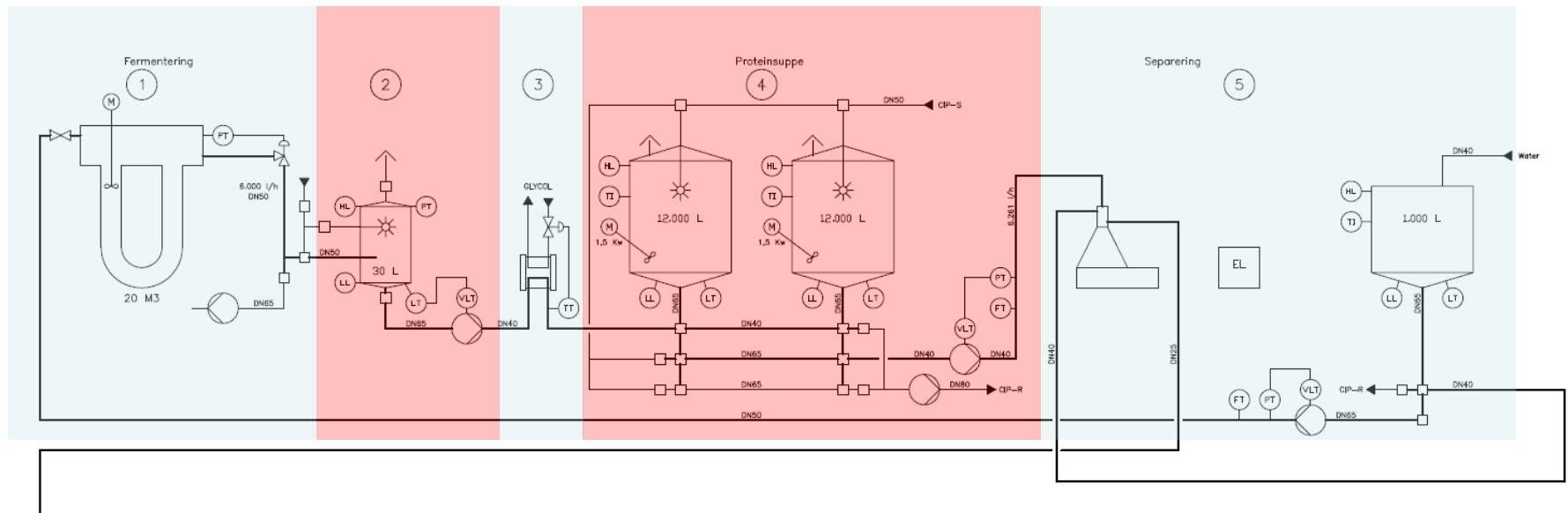
U-Loop Reactor
(Fermenter)

Flash
tank

HEX

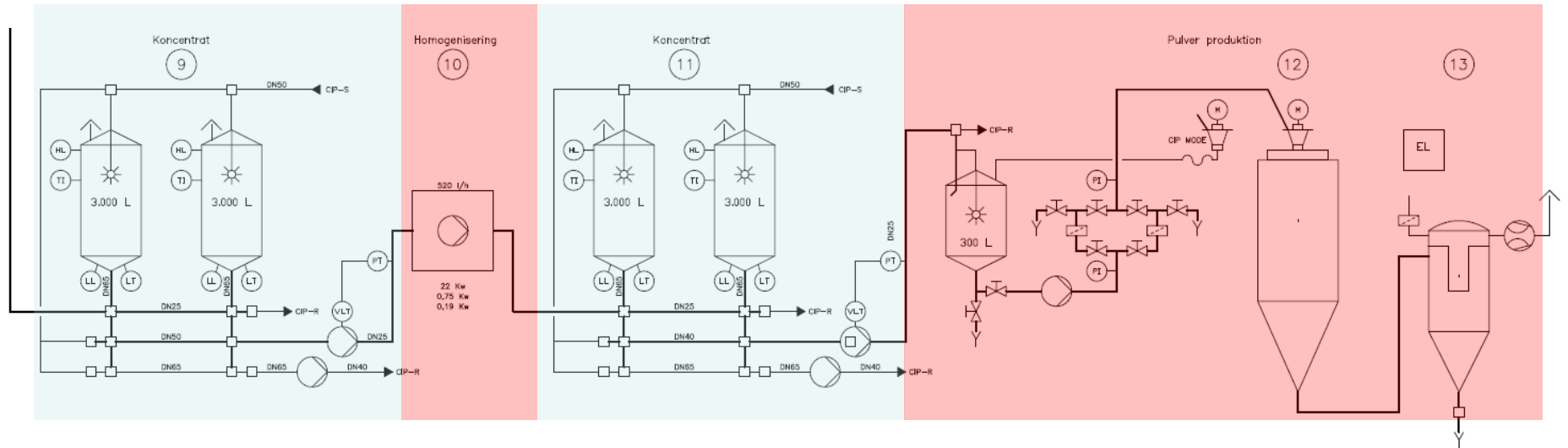
Protein soup
storage tanks

Centrifuge



Protein Concentrate

Down Stream Product Plant



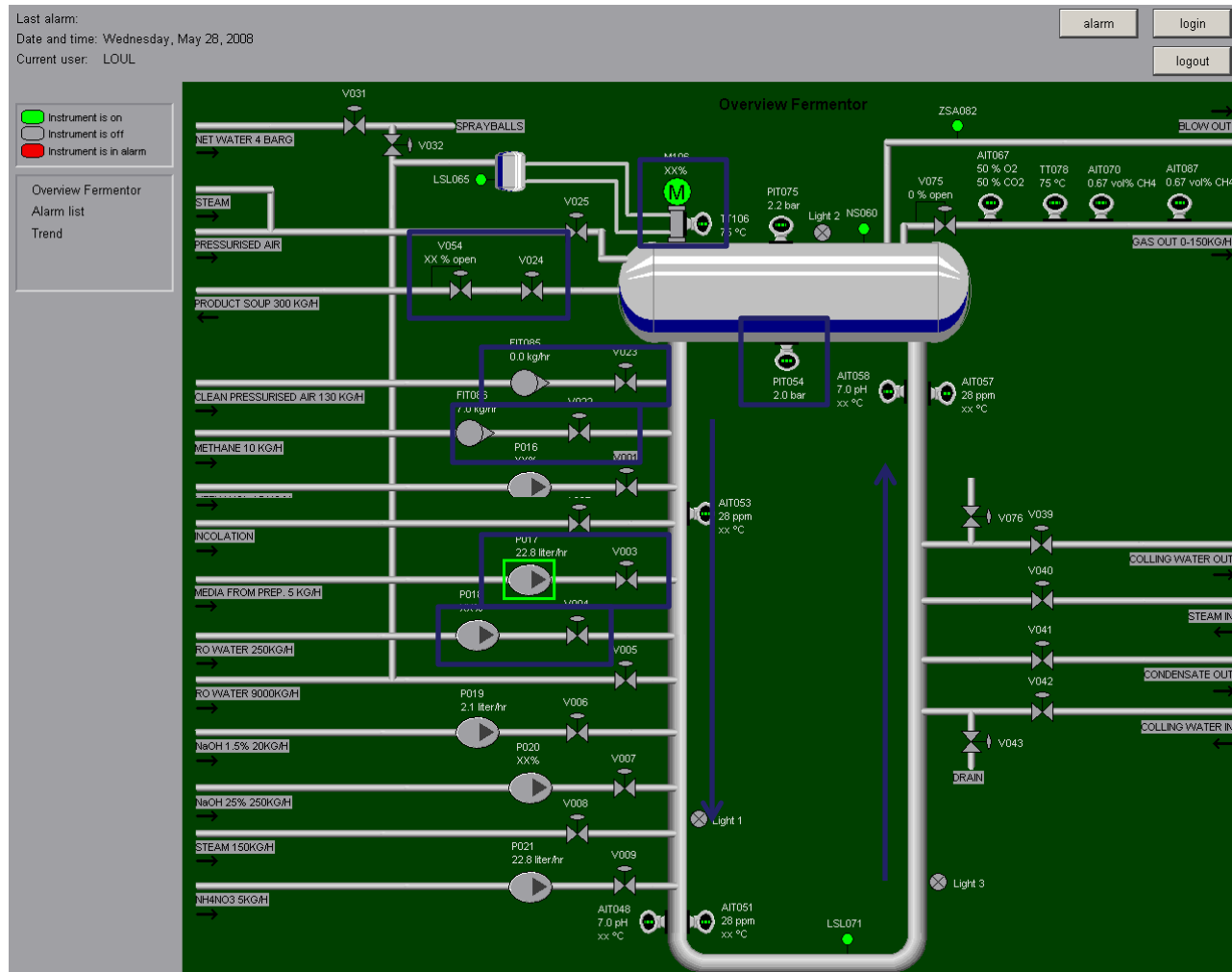
Protein
Concentrate
Tanks

Homogenizer Homogenized
Protein
Concentrate
Tanks

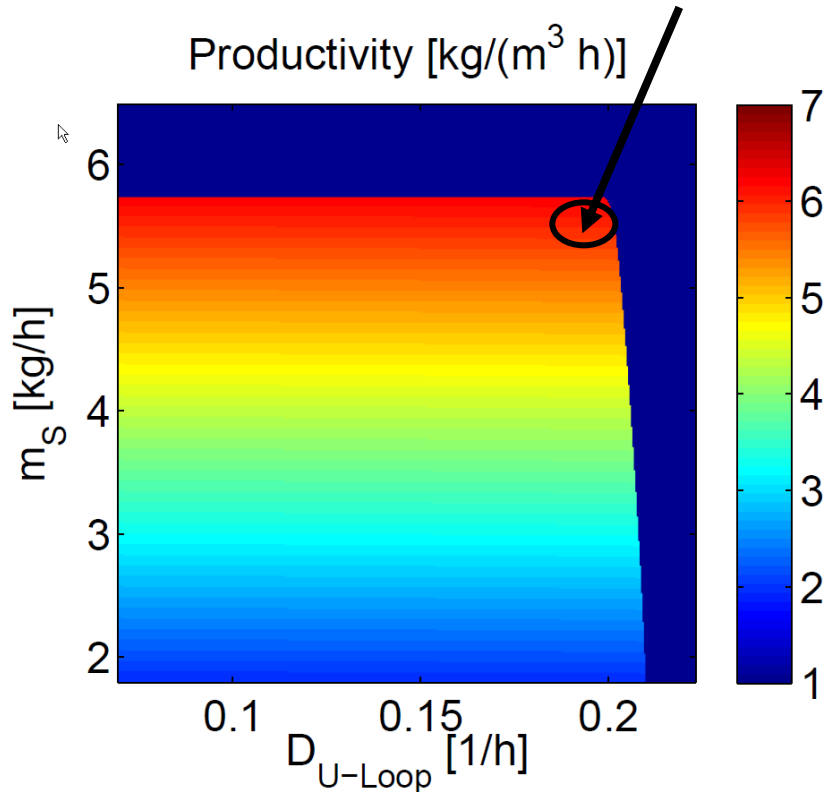
Spray Dryer **UniProtein®**

IT System

Control System & Simulator

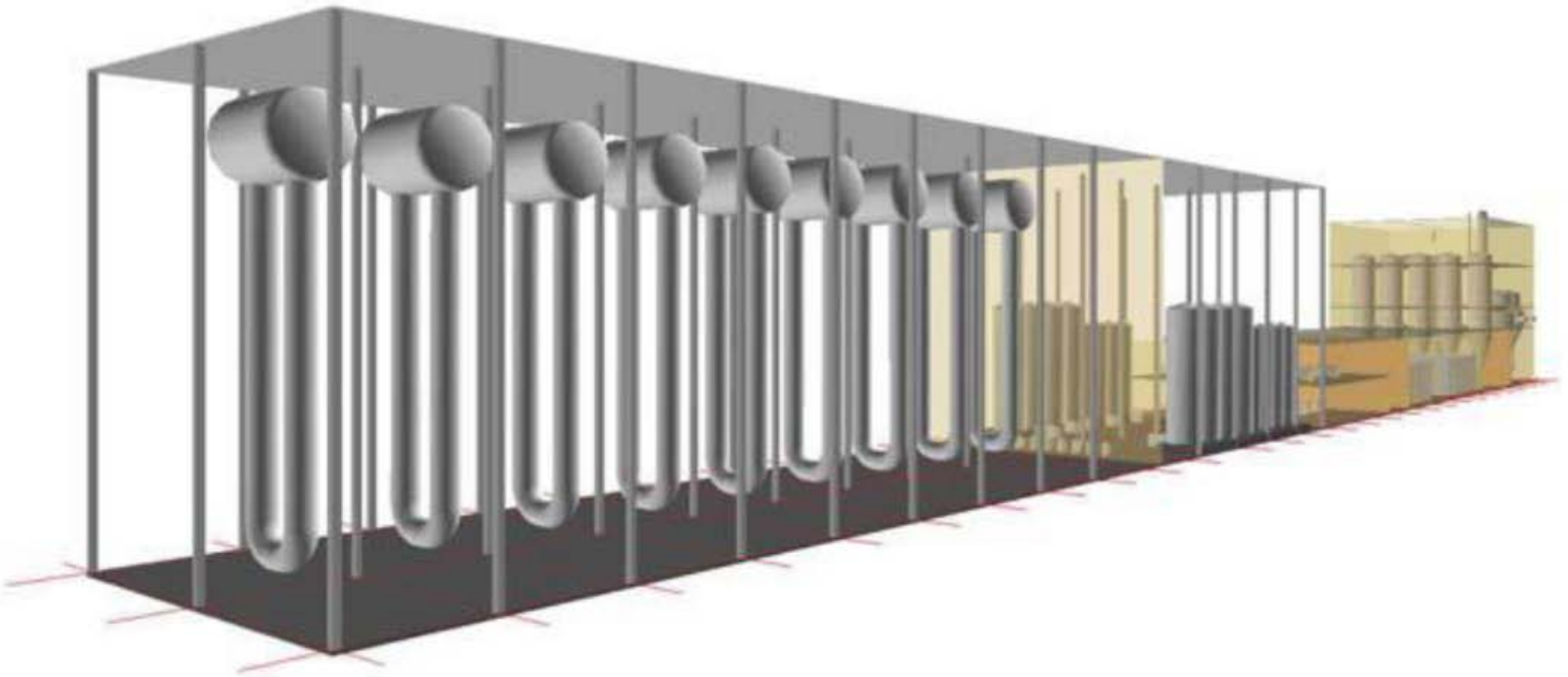


On-Line Production Optimization

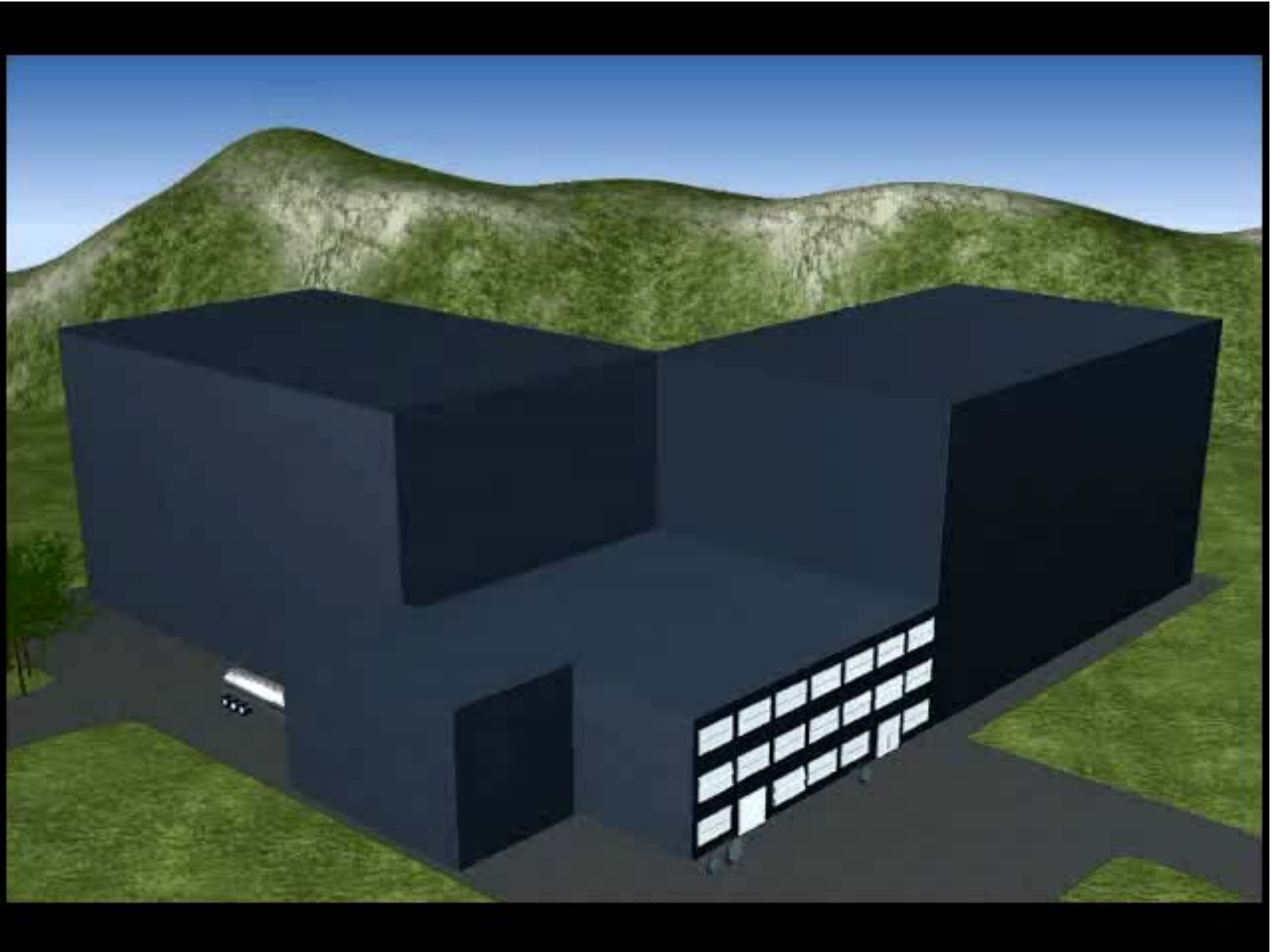


- Computerized control systems uses rolling horizons to keep the fermenter at the optimal productivity (the boundary) despite disturbances
- Fully automatic
- Significant yield increases have been observed

Plant Layout

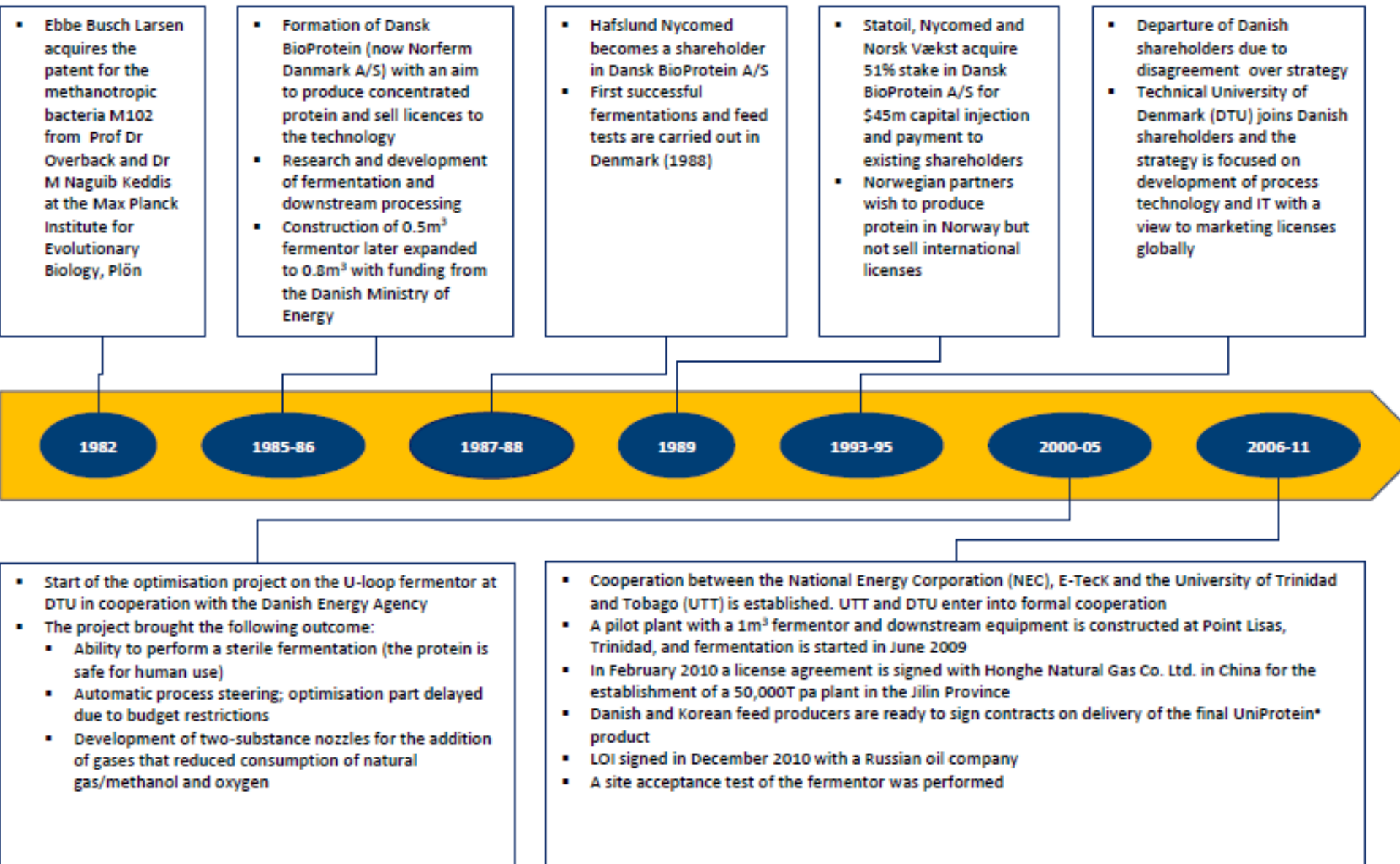


UniProtein[®] Plant Vision



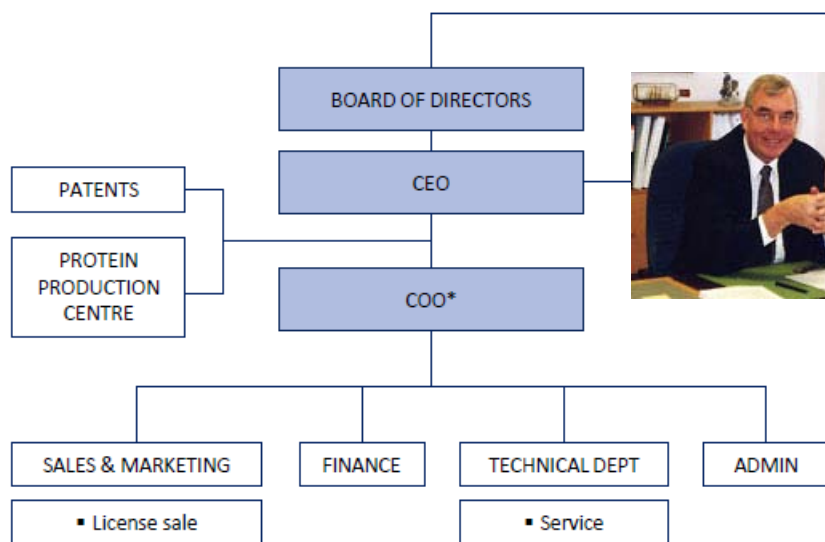
UNIBIO A/S

The History of UniBio A/S



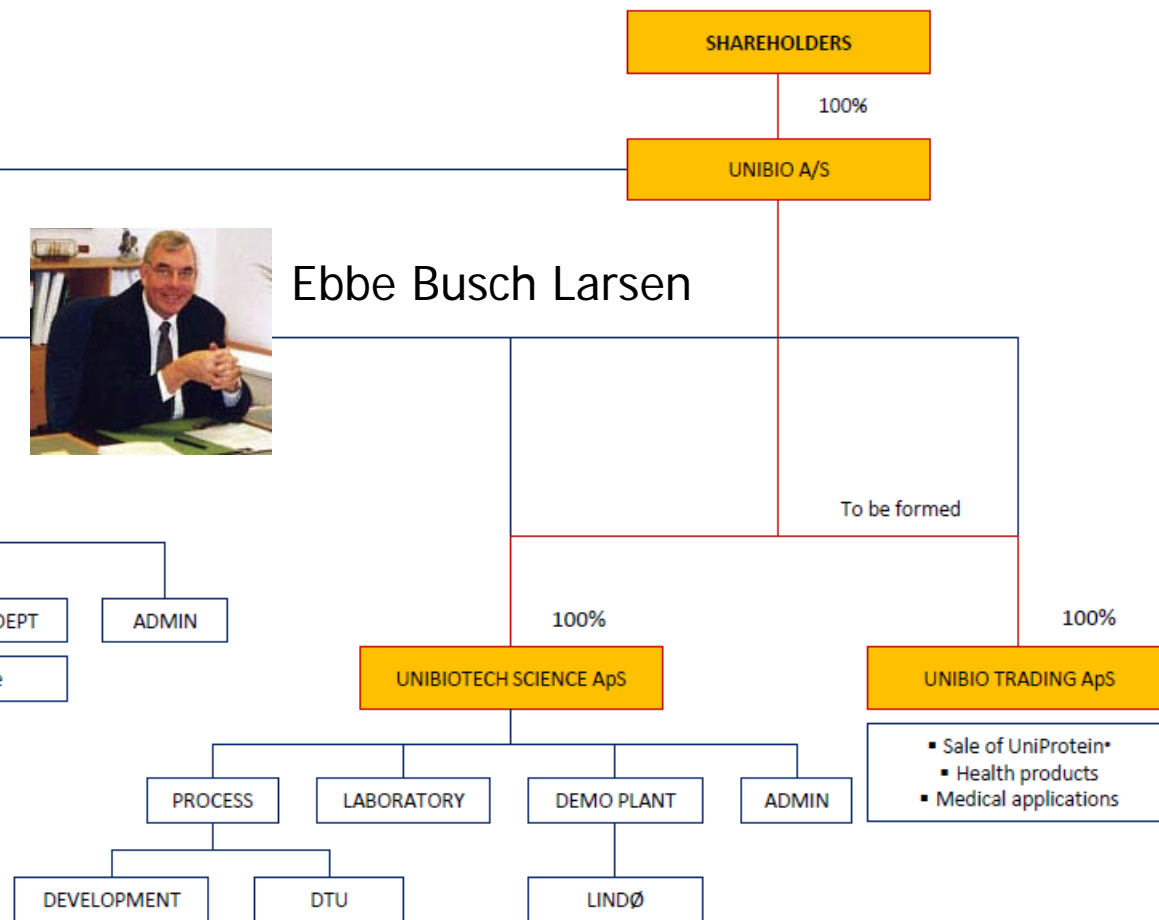
UniBio A/S

ORGANISATION STRUCTURE

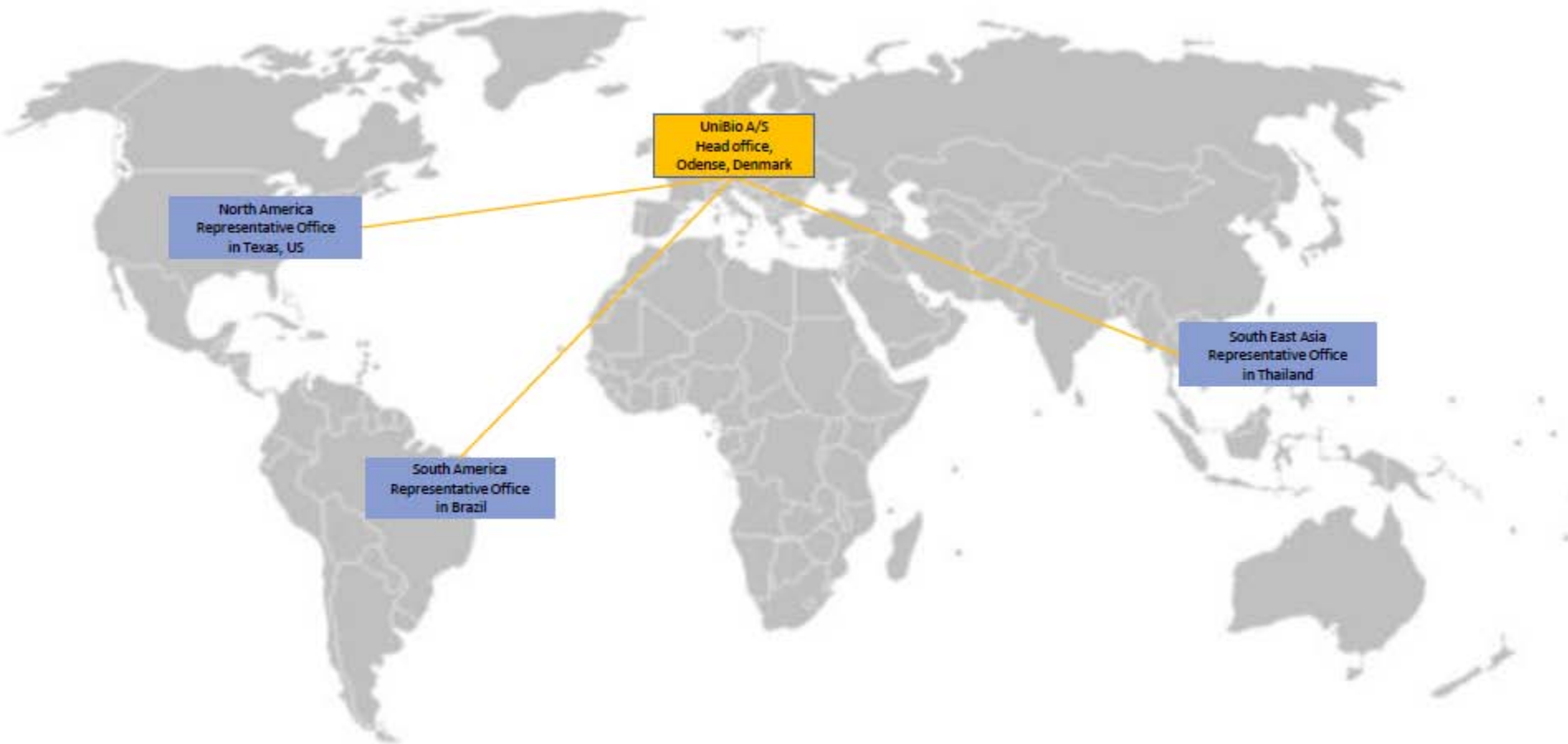


Ebbe Busch Larsen

CAPITAL STRUCTURE



UniBio's Offices



Private-Public Collaboration



UniBio A/S
(private company)



Technical University
of Denmark



Several departments and research centres at DTU involved:

- DTU Chemical Engineering
- DTU Systems Biology
- DTU Informatics
- DTU Food
- Computer Aided Process Engineering Center
- Center for Energy Resources Engineering
- Scientific Computing
- IPU (product development centre)

MARKET POTENTIAL & BUSINESS OPPORTUNITIES

Compound Feed Industry Dilemma

- Most important protein sources used by the compound feed industry
 - Protein oilseed meals
 - Rendered animal products (e.g. bonemeal)
 - Fishmeal
- Fishmeal production is in decline due to overfishing and depletion of fish stocks in seas. Fishmeal will be increasingly scarce
- The compound feed industry faces a dilemma due to the expected adverse development in the supply/demand situation for protein sources
- FAO suggests improving the efficiencies of the technologies used in food production

Production of compound feed in the world and in selected countries in 2010

Protein is the key building block of feed formulation recipes for production of compound feed.

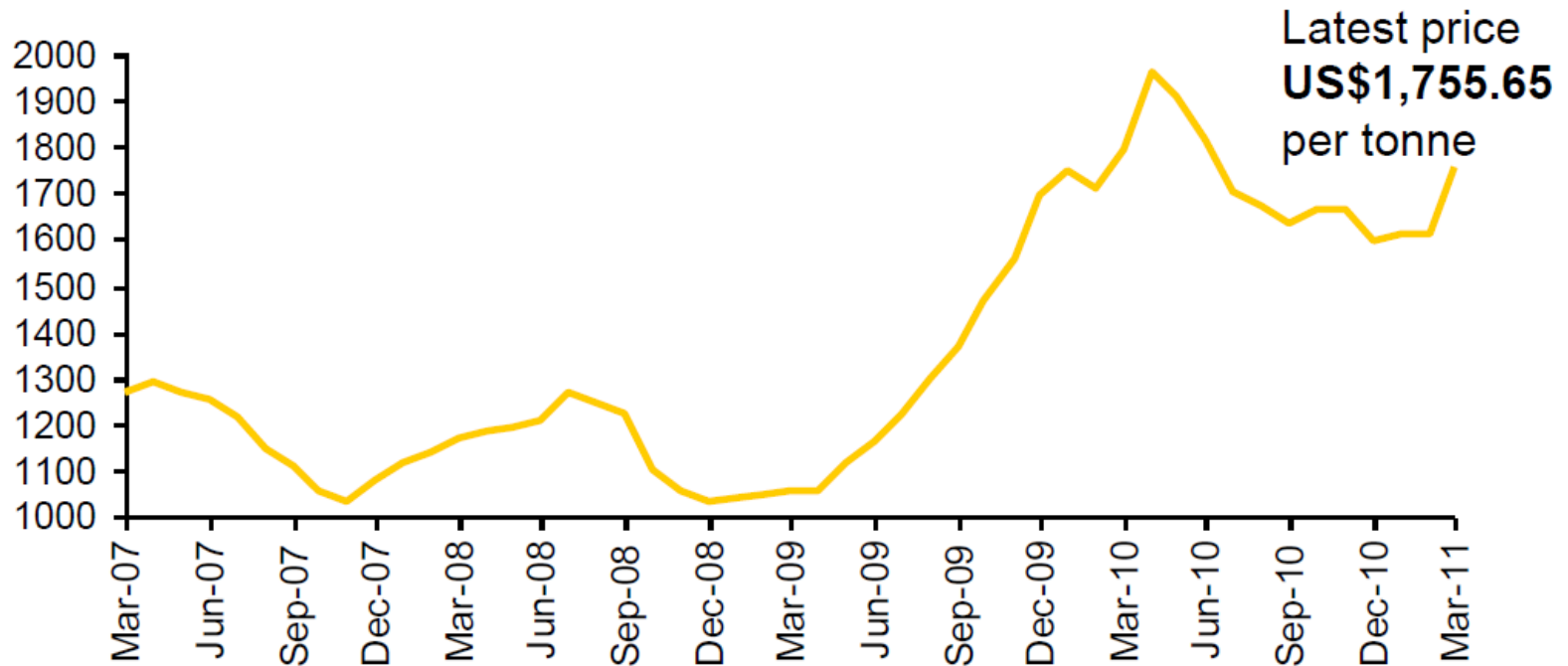
Protein content in compound feed is 20% on average

100.000 tonnes/year factories

UniProtein factories will be sited close to sources of cheap natural gas

	Feed	Protein (100%)	UniProtein® (71%)	UniProtein® factories	Market share 10%
	M t	M t	M t		
Global production	657	131.4	185.1	1,851	185
Asia-Pacific					
China	76	15.2	21.4	214	21
Japan	24	4.8	6.8	68	7
Korea	15	3.0	4.2	42	4
India	10	2.0	2.8	28	3
Thailand	9	1.8	2.5	25	3
Taiwan	8	1.6	2.3	23	2
Malaysia	5	1.0	1.4	14	1
Americas					
USA	162	32.4	45.6	456	46
Canada	23	4.6	6.5	65	6
Brazil	50	10.0	14.1	141	14
Argentina	7	1.4	2.0	20	2
Europe					
Germany	20	4.0	5.6	56	6
France	22	4.4	6.2	62	6
Denmark	6	1.2	1.7	17	2
Belgium	7	1.4	2.0	20	2
Hungary	5	1.0	1.4	14	1
Poland	7	1.4	2.0	20	2
UK	11	2.2	3.1	31	3
Spain	21	4.2	5.9	59	6
Netherlands	13	2.6	3.7	37	4
Italy	13	2.6	3.7	37	4
Russia	18	3.6	5.1	51	5
Ukraine	5	1.0	1.4	14	1
Africa/ Near East					
South Africa	9	1.8	2.5	25	3
Egypt	5	1.0	1.4	14	1
Turkey	6	1.2	1.7	17	2
Saudi Arabia	5	1.0	1.4	14	1
Total	562	112.4	158.3	1,583	158

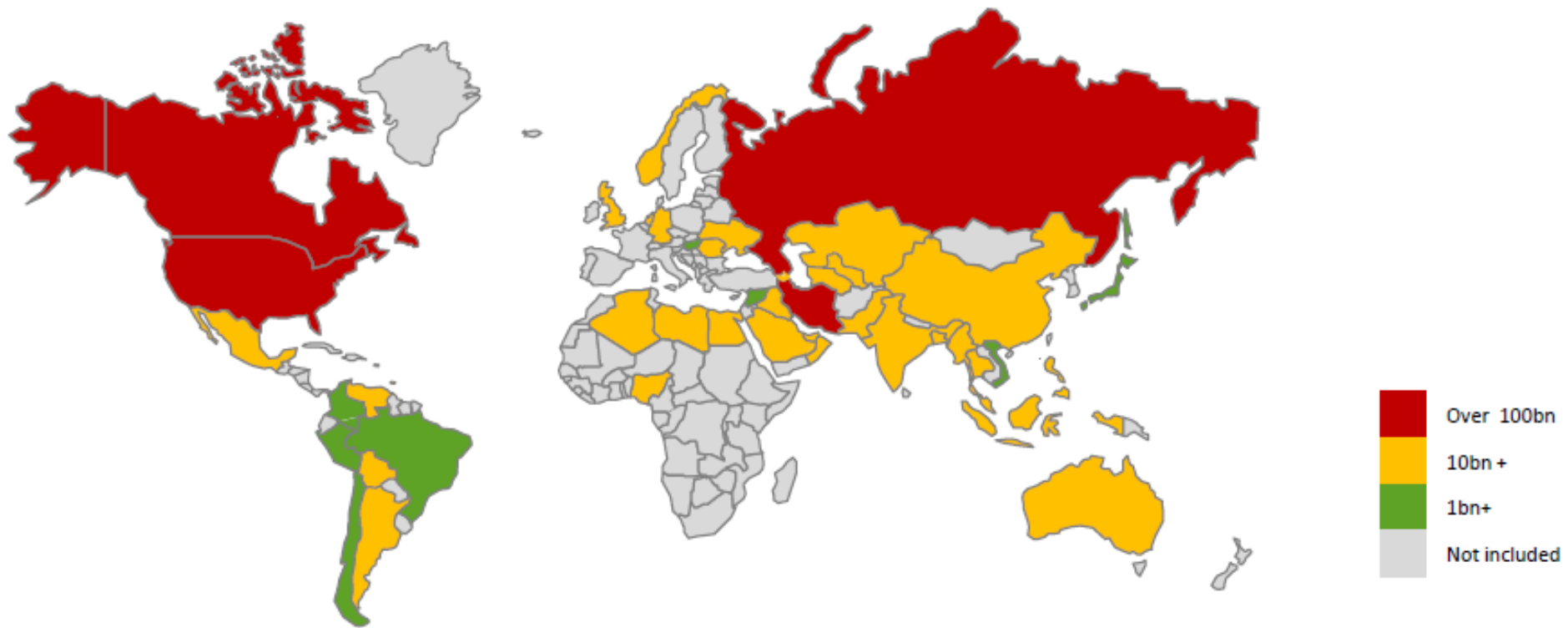
CIF PERU FISHMEAL PRICE PERFORMANCE



Source: Index Mundi

- UniProtein® is a very close substitute to high quality fishmeal (LT)
- UniProtein® was approved as animal nutrition in the EC; Commission Directive 95/33/EC of 10 July 1995
- The aquaculture industry is the first target in the marketing as they are the biggest consumers of fishmeal

NATURAL GAS PRODUCERS AND PROVEN GAS RESERVES BY COUNTRY



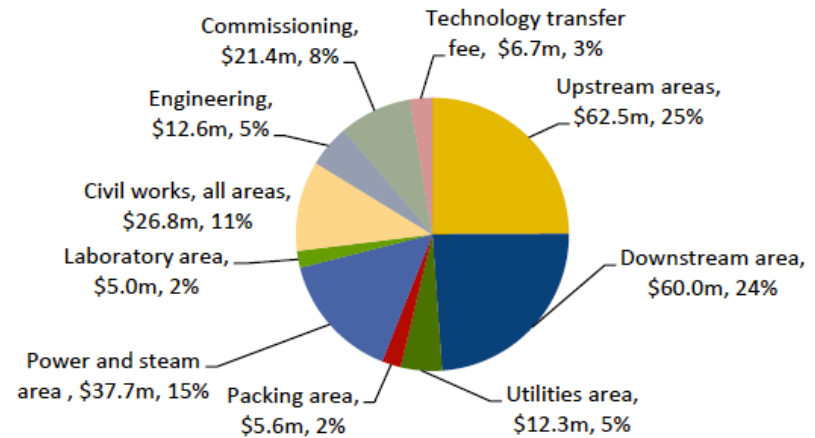
- Nearly 150 billion cubic meters of of natural gas are being flared and vented annually by the oil industry
- This is equivalent to
 - 25% of gas consumption in USA
 - 30% of gas consumption in Europe
 - 75% of Russia's gas export
- Gas flaring has an impact on global warming. We can use that gas for making animal feed!



Financial data - Economics of a UniProtein® plant

- The investment cost is shown in the chart opposite, broken down into its components
- In the calculations we have assumed that the investment cost can be financed 70% by a bank loan (\$175.8m) paying interest of 8% and amortising over 10 years
- The balance of \$75.2m plus \$32.6m of working capital is financed by equity
- With the present price relation between fishmeal and natural gas, the calculations show that the production of UniProtein® is very profitable
- With the higher productivity of the pressure/pressureless system and optimised IT control system, profitability is even higher
- UniBio's strategy is to sell licences, develop its technology and act as a sales agent for UniProtein® in the European market. Therefore UniBio will not invest its own capital in protein plants
- However UniBio is interested in assisting an associated company to invest in protein plants as this will guarantee its future revenues

PLANT CAPEX, \$251m



DESCRIPTION OF MAIN COST AREAS

Upstream areas	Pre-fermentor, Fermentor, Fermentor equipment
Downstream area	Centrifuge, Heat treatment, Spray drying
Utilities area	Media preparation / chemicals, Methane, Oxygen, Ammonia, NaOH, Cooling, Steam, Sterile steam, Heat, Water, Pressurised air, Sterile air, HVAC
Packing area	Packing station
Power and steam area	Power, Steam, Transformer, Main board, Electrical installation, process equipment; Electrical installation, civil; Control room, SCADA, HW, SW; PLC, HW, SW; Data server and client, HW, SW
Laboratory area	Centrifuge, Autoclave, Equipment
Civil works, all areas	Surroundings, roads, parking etc.



Financial data - Scenario analysis – 100% owned case

KEY OPERATING ASSUMPTIONS

Gas price	NYMEX Henry Hub \$0.15 per m ³
Land and Building	Supplied by energy partner
Capital provision	Investor provides all capital
Profit distribution	100% to investor
Project term	10 years, zero terminal value
UniProtein® price	\$2,000 per tonne
Equity amount	\$110.4m including working capital
Loan amount	\$175.8m

PROFIT AND LOSS ACCOUNT

US\$	30/09/2014	30/09/2015	30/09/2016	30/09/2017	30/09/2018	30/09/2019	30/09/2020	30/09/2021	30/09/2022	30/09/2023
Turnover after royalty	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536
Variable costs	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)	(63,354,975)
Overheads	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)
Operating margin	146,992,260	146,992,260	146,992,260	146,992,260	146,992,260	146,992,260	146,992,260	146,992,260	146,992,260	146,992,260
Depreciation	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)
Operating income	121,883,990	121,883,990	121,883,990	121,883,990	121,883,990	121,883,990	121,883,990	121,883,990	121,883,990	121,883,990
Interest	(14,060,632)	(12,654,568)	(11,248,505)	(9,842,442)	(8,436,379)	(7,030,316)	(5,624,253)	(4,218,189)	(2,812,126)	(1,406,063)
PROJECT INCOME BEFORE TAX AND JV	107,823,358	109,229,421	110,635,484	112,041,548	113,447,611	114,853,674	116,259,737	117,665,800	119,071,863	120,477,926
Contribution to JV Partner	-	-	-	-	-	-	-	-	-	-
PROFIT BEFORE TAX	107,823,358	109,229,421	110,635,484	112,041,548	113,447,611	114,853,674	116,259,737	117,665,800	119,071,863	120,477,926
Tax	(26,955,840)	(27,307,355)	(27,658,871)	(28,010,387)	(28,361,903)	(28,713,418)	(29,064,934)	(29,416,450)	(29,767,966)	(30,119,482)
NET INCOME	80,867,519	81,922,066	82,976,613	84,031,161	85,085,708	86,140,255	87,194,803	88,249,350	89,303,897	90,358,445

KEY OUTPUTS

Equity IRR	44.3%
Multiple of money	7.8x
Equity payback period	16 months post construction
NPV of royalties to UniBio	\$50m at 10% pa

SENSITIVITY ANALYSIS

		Production kg /m3 /h					
		3.50	4.00	4.50	5.00	5.50	6.00
Operating time	80.0	33.5%	39.2%	44.3%	49.0%	53.3%	57.4%
	82.5	34.8%	40.5%	45.6%	50.4%	54.8%	58.9%
	85.0	36.1%	41.8%	47.0%	51.7%	56.2%	60.3%
	87.5	37.3%	43.0%	48.3%	53.1%	57.5%	61.7%
	90.0	38.5%	44.3%	49.5%	54.4%	58.9%	63.1%



Financial data - Scenario analysis – 50/50 Joint Venture case

KEY OPERATING ASSUMPTIONS

Gas price	Free gas supplied by JV partner
Land and Building	Supplied by JV partner at no cost
Capital provision	Investor provides all capital
Profit distribution	JV partner gets 50% of profits
Project term	10 years, zero terminal value
UniProtein® price	\$2,000 per tonne
Equity amount	\$107.8m including working capital
Loan amount	\$175.8m

KEY OUTPUTS

Equity IRR	35.6%
Multiple of money	5.8x
Equity payback period	21 months post construction
NPV of royalties to UniBio	\$50m at 10% pa

SENSITIVITY ANALYSIS

		Production kg /m3 /h					
		3.50	4.00	4.50	5.00	5.50	6.00
Operating time	80.0	27.1%	31.5%	35.6%	39.4%	42.9%	46.3%
	82.5	28.1%	32.6%	36.7%	40.5%	44.1%	47.4%
	85.0	29.1%	33.6%	37.8%	41.6%	45.2%	48.6%
	87.5	30.0%	34.6%	38.8%	42.7%	46.4%	49.8%
	90.0	31.0%	35.6%	39.9%	43.8%	47.4%	50.9%

PROFIT AND LOSS ACCOUNT

US\$	30/09/2014	30/09/2015	30/09/2016	30/09/2017	30/09/2018	30/09/2019	30/09/2020	30/09/2021	30/09/2022	30/09/2023
Turnover after royalty	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536	216,841,536
Variable costs	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)	(10,623,298)
Overheads	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)	(6,494,301)
Operating margin	199,723,938	199,723,938	199,723,938	199,723,938	199,723,938	199,723,938	199,723,938	199,723,938	199,723,938	199,723,938
Depreciation	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)	(25,108,271)
Operating income	174,615,667	174,615,667	174,615,667	174,615,667	174,615,667	174,615,667	174,615,667	174,615,667	174,615,667	174,615,667
Interest	(14,060,632)	(12,654,568)	(11,248,505)	(9,842,442)	(8,436,379)	(7,030,316)	(5,624,253)	(4,218,189)	(2,812,126)	(1,406,063)
PROJECT INCOME BEFORE TAX AND JV	160,555,035	161,961,099	163,367,162	164,773,225	166,179,288	167,585,351	168,991,414	170,397,478	171,803,541	173,209,604
Contribution to JV Partner	(80,277,518)	(80,980,549)	(81,683,581)	(82,386,612)	(83,089,644)	(83,792,676)	(84,495,707)	(85,198,739)	(85,901,770)	(86,604,802)
PROFIT BEFORE TAX	80,277,518	80,980,549	81,683,581	82,386,612	83,089,644	83,792,676	84,495,707	85,198,739	85,901,770	86,604,802
Tax	(20,069,379)	(20,245,137)	(20,420,895)	(20,596,653)	(20,772,411)	(20,948,169)	(21,123,927)	(21,299,685)	(21,475,443)	(21,651,200)
NET INCOME	60,208,138	60,735,412	61,262,686	61,789,959	62,317,233	62,844,507	63,371,780	63,899,054	64,426,328	64,953,601

QUESTIONS & CONTACT INFO



UniBio A/S

UniBio A/S
Billedskærervej 8
5230 Odense M
Denmark

Phone: +45 63 104 040

Web: www.unibio.dk
E-mail: unibio@unibio.dk



HARNESSING TECHNOLOGY TO PRODUCE PROTEIN FOR ANIMAL FEED USING
VENTED OR FLARED GAS IN OIL FIELDS

*“Our mission is to sell licenses to
fermentation and production of
UniProtein® worldwide”.*